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JOINT, NERVE, AND OTHER INJURIES IN WAR SURGERY[1]

BY SIR ROBERT JONES, K.B.E., C.B., M.CH., F.R.C.S., LIVERPOOL, ENGLAND

I APPRECIATE more deeply than I can express the great honor you have done me by inviting me to address you as a delegate from Britain. The admiration I have for the surgery of America and for the countless personal friends who practise it would alone make this voyage memorable to me; but, in addition to this, I can never forget the debt under which we are placed for help given to us at a very critical period at home.

The loan of twenty-five keen and experienced young surgeons placed at my disposal for the duration of the war, equipped and paid for by the American Government, has placed an obligation upon us very difficult to repay, and which I can only express in terms of affectionate gratitude. How that band of twenty-five rapidly swelled to close upon a hundred is known to many of you; but we on the other side, who lived among them, inspired by their energy, their sense of responsibility, their loyalty and devotion to duty, can alone speak of the sweet memories they have left behind. They filled a gap which seriously threatened to sterilize our reconstructive efforts and they filled it with distinction and success.

When your nation entered upon the war, most of our more tragic problems were being overcome. Sepsis and gas gangrene had largely lost their terrors. Shock was being adequately dealt with; wounded men at advanced units were promptly and effectively handled; continuity of treatment from regimental aid post to the base was being secured, and standardization of principles and methods appreciated and practised. Team-work was in full swing, while the segregation of special cases under expert men had already made advance.

But in the early days of the war, when the wounded passed into our country in countless numbers, our hospitals soon became full to overflowing. The same conditions were experienced in France. There was nothing for it but to evacuate the less serious cases to make room for others, with the result that our towns and even villages began to feel the burden of the cripple. If the men were not discharged they were found segregated in command depots, and these depots from their nature were not equipped with the personnel which could effectively deal with them.

A visit through these large camps very easily proved to us that it was necessary to have certain hospitals governed by less stringent rules, where every accommodation should be provided for the type of case which required a sufficiently protracted stay to prevent deformity and to restore function. At Sir Alfred Keogh's request, an experiment was first made in Liverpool, where 250 beds were placed at our disposal. Later, in Liverpool this number grew to 1500, and fresh centers were started in Great Britain and Ireland until the number reached over 25,000.

[1] An address presented before the Clinical Congress of American College of Surgeons, New York City, October 20-24, 1919.

Difficult as it was to find beds, it was even more difficult to find surgeons to superintend them, for all medical men under 45 were commandeered for foreign service and it was the *young* men who were badly needed—men of sound surgical training, with minds sufficiently open and flexible to grasp and solve new problems.

Visits to general hospitals and command depots clearly proved that without segregation and continuity of treatment, we were in danger of scrapping thousands of cases who possessed the potentialities of recovery; and these were not merely the serious cases, but also those lesser injuries upon the recovery of which we depended in order to replenish our fighting forces.

Among the cases we met with in these tours of inspection were malunited and ununited fractures, especially femurs. Stiff and ankylosed joints; flail joints; the after-effects of injuries to peripheral nerves; and deformities due to the contraction of scars. Many of these conditions were recoverable, and most of them might have been prevented.

These cases, when admitted into our centers, had usually been to several hospitals. They were generally discontented and by no means willing to undergo any further manipulated or operative attack. They did not necessarily come from our small auxiliary hospitals, but often from those institutions where, in normal times, we would find the most skillful and eminent surgeons.

Our first effort consisted in endeavoring to improve the mental outlook of the men and in making every effort to humanize the hospital. Persuasion and explanation took the place of command and penalty, and our various centers with their annexes became hives of industrious and contented men. In a very short time they were prepared to submit to anything we wished.

The segregation into large centers of so widely different groups of cases involved great responsibility, more especially the nerve cases. Frequently I had been told by neurologists who operated in various hospitals that they were quite unable to follow their cases; there was no possibility of retaining them in the war hospitals, where convoys continually arrived, for much longer than it required to heal the wound. They were evacuated and found again in various small country hospitals, or even in command depots, under conditions anything but desirable. These cases consequently had to be admitted to our centers, and it was therefore necessary to secure the service of eminent neurologists to help in the treatment. As most of the nerve injuries were accompanied by other lesions they were very admirably placed for general supervision.

NERVE INJURIES

It may be of interest to mention briefly certain lessons we have learned in the treatment of these peripheral nerve injuries. The complications were such that we were often obliged to wait until they were overcome before any operation could be undertaken. Suppurating wounds, involving bones, muscles and tendons, and stiffness of joints, all delayed an attack upon the nerve. Muscles had to be freed and developed; and osteomyelitis drastically extirpated in order to render the muscles receptive to impulse. The sooner these complications were overcome or improved the better the chance for the nerve, not because delay in operating upon the nerve lessened the chance of regeneration, but because a chronic myositis very seriously impaired the power of the muscle to react when recovery of the nerve path was re-established.

Experience taught us that it was better to explore earlier and more frequently than we did at the beginning of the war.

It is found that if a nerve is simply contused or compressed, and has undergone wallerian degeneration, it will early show signs of recovery. In cases which do not spontaneously recover in a month or two, it is usually a mistake to await regeneration of the nerve, and an exploratory operation should be undertaken. Inspection of the exposed nerve at the time of operation and its faradic excitability should be regarded as a part of the diagnosis. It is essential in such cases that the surgeon should be experienced in nerve surgery, and be prepared to close the wound without interfering with the nerve, if it has an intact sheath and gives a faradic

response when tested with a weak current. It is probable that no interval between wound and operation is too long to preclude possible recovery after suture. The state of the muscles, tendons, and joints is the important factor.

It has been found in practice that end-to-end suture can be attained in the great majority of cases by flexing of joints, adduction of arm, and transposition of nerves. In the rare instances where the nerve could not be brought together we found this could be accomplished by a two-stage operation. Silk was tied around the bulbs and they were brought together as nearly as possible, extra length being secured by posturing the limb. The wound was then closed and gradual traction applied to the nerve through the limb for some weeks. At the second operation it was found that the ends could usually be brought together. It is needless to emphasize the importance of approaching the nerve through normal tissue above and below the lesion were it not that even yet surgeons may be found making the exploration through scar tissue. Nothing is to be gained from surrounding the suture line with vein or cargile membrane or fat introduced from without. If the nerve has to be protected from scar tissue, a living muscular flap is indicated, but, whenever possible, the scar tissue should be freely excised. The Medical Research Committee, whose report is not yet published, have carefully investigated a large number of cases operated upon. In the case of nerve grafting they have not met with one case of complete recovery, and with but very few partial recoveries. Most cases have ended in complete failure. Bridging by catgut, vein, alcoholized nerve and other foreign material has consistently disappointed. The turning down of flaps of nerve, and nerve crossing or anastomosis, i. e., implanting the distal end of the divided nerve into a healthy one, invariably fails. The conclusion come to is that end to-end suture by a one stage, or if necessary, two stage operation, is the method to be adopted in every case.

In cases of irreparable damage to the musculospiral or posteri interosseous tendon transplantation when properly performed has proved an unqualified success. It must be associated with a good technique, and be followed by careful re-education. The operation I suggested in pre-war days with certain modifications I still recommend, but I advocate a more frequent use of the pronator radii teres. The flexor carpi radialis and the flexor carpi ulnaris can be transplanted into the paralyzed extensors of thumb and fingers, and the pronator radii teres may be affixed to the radial extensors. In transplanting tendons it is important to pay careful attention to the correct tension, and for this purpose the hand and fingers should be kept well dorsiflexed when the attachments are being made, and the transplanted tendon must run a straight course from its origin to its new insertion. Attention to these points will make the difference between success and failure. If the operation is a real success, the fingers and thumb can be easily fully extended. Tendon transplantation with the object of merely dorsiflexing the wrist should be discouraged, and tendon fixation with the object of permanently fixing the wrist in dorsiflexion should be reserved for those cases where transplantation has been a failure and where the extensor muscles and tendons have been destroyed.

Paralysis of the anterior crural is very rare, probably because the femoral vessels are usually destroyed by the missile. We have here a choice of hamstrings to attach to the patella. Strangely enough, I have only met with one case, and in this instance the recovery after transplantation was sufficiently good to permit of climbing stairs with increasing power.

Tilanus, of Holland, some twenty years ago, suggested an operation for flail feet in poliomyelitis which he termed tenodesis. He used paralyzed tendons as ligaments in order to sling the foot at right angles. Gallie and others have worked on similar lines. This operation, with modifications, we have found helpful in drop foot, due to sciatic injury where suture is impossible.

The peroneus longus is cut about three inches above the external malleolus, and the tendon is withdrawn through an incision

above the base of the fifth metatarsal. The loose tendon is then passed through the annular ligament and through a tunnel bored through the tibia. The tibialis anticus is also cut and passed through the same tunnel. The tibialis is passed from within outward, the peroneus from without inward. The foot is dorsiflexed to a shade beyond the right angle, and the transplanted tendons are drawn tight and attached to each other. The peroneus brevis is cut and attached to the fibula. The result of the operation is very satisfactory, much more so than in the case of children, where problems of growth have to be considered.

The prognosis as regards functional utility after nerve suture depends very largely upon which particular nerve has been injured. Thus, the musculospiral usually makes a good recovery, while the ulnar, as regards the intrinsic muscles of the hand, does badly. Another factor of importance in prognosis is the occupation of the patient. A man with an ulnar nerve lesion will usually recover both sensation and muscular control quite well enough for most trades, but he will not recover control of the finer movements of the hand, such as are needed for piano playing.

After the musculospiral, in order of good recoveries, we must place the sciatic. The results of suture here are surprisingly good. A large number of our cases were examined two or three years after suture. Some of these men could jump, climb ladders and run, and many have returned to their pre-war employment.

The brachial plexus often makes a good recovery, especially the upper part. Plexus lesions should be watched for a long time, 6 to 9 months, or more, and not operated on for exploratory purposes as are the nerves themselves, because they frequently make excellent progress, and a generalized paresis may later be limited to one cord, or nerve.

Median injuries do fairly well, the thumb intrinsics even functioning in some cases, while it is usual for the wrist flexors and considerable sensation to recover. Sensation, however, is usually lost, or very slowly or rarely recovered from, over the terminal phalanx of the index fingers.

The ulnar recoveries are good as regards wrist and finger flexors, and even its sensory disturbance clears up well. As has been stated, good recovery of the interossei is very rare. They may and do recover their faradic excitability more often than voluntary power.

Combined lesions of the median and ulnar, particularly if complicated by ligation of the artery, do very badly. There is usually the stiff, rigid, board-like hand with joint changes, still further to hinder the chance of good function. This is indeed the important obstacle.

The after-treatment of cases of peripheral nerve injury has not undergone much change. The relaxation of muscles is essential, and it is also necessary that the relaxed position of the nerve should not be too early dispensed with, otherwise the recently regenerated axis cylinders will be ruptured. Interrupted galvanic stimulation, massage, heat and re-education are indispensable desiderata.

A series of very interesting trick movements have to be carefully watched for, when we test the amount of recovery following suture, or when we are making a diagnosis. Unless the surgeon is familiar with their occurrence, he is very liable to be misled.

In complete paralysis of certain muscles and muscle groups, the unaffected muscles acting in combination can replace the movements lost by paralysis in a very remarkable manner. For instance:

1. The opponens pollicis can be perfectly imitated by the ulnar adductors of the thumb in combination with the extensor ossis.

2. The extensor ossis may act as a good wrist flexor in cases of complete paralysis of all median and ulnar muscles.

3. The fingers may be closed in complete median and ulnar paralysis by extending the wrist when the inelastic paralyzed flexor tendons acting as ligaments permit the fingers to flex mechanically.

4. The elbow may be flexed by the pronator radii teres in combined lesions of musculocutaneous and musculospiral nerves.

5. Flexion of the fingers may extend the wrist in lesions of the musculospiral, simulating the movement of the wrist extensors.

6. In paralysis of postinterosseous exten-

sion of the thumb may be simulated by the opponens pollicis and abductor brevis, the contraction of which muscles lengthens the distance between the origins and insertions of the extensors of the thumb.

Although electrical stimulation will generally teach us to discriminate between the true and spurious movements, the observer must be on the alert, or he will be quite easily deceived.

BONE INJURIES

Sir Anthony Bowlby, to whose vision and organization we owe so much for surgical efficiency at the front, has already addressed us on "Fractures of the Femur" as he met with them in France. In the early days of the war, these injuries supplied our centers with a large proportion of deformities. In 1917, I described gunshot injuries of the femur as "the tragedy of the war," not only by reason of the fatality by which they were attended but also because of the deformity and shortening so often associated with them. This was due to the absence of effective team-work at home and abroad; a want of standardization of principles and splints, and of continuity of treatment from front to base and of the segregation of these injuries in special hospitals under expert men. I have it on the authority of Gray, who collected statistics over one of the Army areas in 1916, that the mortality from these fractures amounted to almost 80 per cent, a large proportion of deaths occurring in their way to, or at, the casualty clearing stations. In the year 1918, Sir Anthony Bowlby tells us that the mortality in field ambulances and in casualty clearing stations was reduced to less than 20 per cent.

To what are we to ascribe this dramatic change? First and foremost to the recognition, too long delayed, of the value of the Thomas splint, and to its distribution to the regimental aid posts. We cannot give too much credit to Sir Henry Gray for the work he did in this connection. In pre-war days a certain kind of homage was paid to the Thomas splint, but that was all. Its use was strictly limited, and in spite of its simplicity very few surgeons knew how to apply it, and in many of our teaching hospitals it was only known by name. In Liverpool we have long taught that fracture of the femur, simple or compound, treated by a Thomas splint should, at the worst, not yield more than half an inch of shortening, and that if a surgeon desired it he could easily produce an appreciable lengthening. It has taken a great war to drive this truth deep home. The caliper splint which has been in use for over forty years was scarcely known. The standardization of the Thomas splint, the education of men in its use, its application on the field of battle, secured for the fracture immobilization and simplified transport, it minimized shock, and it prevented the perforation of vessels by securing the alignment of the broken ends. Its use had to be understood from the field to the base hospital, for continuity of treatment was imperative. At the base hospital it might be necessary in more leisurely fashion to apply modification in response to special requirements. A subjugation of sepsis and gas gangrene also played an important part in these improved statistics, with all those accessories for the prevention and lessening of shock, such as the heated ambulance, and the hot chambers. In addition to this, the mobile expert teams which were rushed from place to place allowed of more skilled and frequent operative treatment. Then came the equipping of special femur hospitals, where some of the best and most inspiring war work was done. In this connection I feel I must refer to the work of Major Sinclair, who displayed remarkable ingenuity, and whose cases arrived in England with barely any shortening and in excellent alignment. To him and to Colonel Pearson and Colonel Watkin Williams we are much indebted for excellent pioneer work. Pearson, who later took charge of one of our large femur hospitals, using the modified Thomas splint to permit of knee flexion, obtained traction by the introduction of ice-tongs calipers which gripped but did not penetrate the femur, and used suspension of the Thomas ring and elevation of the femur. In addition he designed a special bed which rendered dressing easy and painless.

In 300 cases of compound fracture treated

in England in one of the special military surgical centers where this method of extension was employed, the average shortening was half an inch. There can be no doubt that the use of safety ice-tongs caliper splints in the hands of experienced surgeons has been of very great service. The guard should always be affixed to it to prevent it from entering the bone. This is especially important if evacuation takes place during treatment. Many cases arrived in England where the knee-joint and ankle joint had been infected by calipers which were introduced into cancellous tissue and worked their way downward. It must be remembered, however, that fracture of the femur can be effectively treated by the Thomas splint with ordinary extensions. The pressure of the ring can be modified by tying the end of the splint to the end of the bed which is elevated. Of 97 cases which were at the Liverpool Special Military Surgical Center at one time the average shortening was five eighths of an inch, and the skilled nursing secured for the patient freedom from pressure sores and a comfortable convalescence. The extension calipers combined with a free knee-joint undoubtedly minimize a frequently obstinate stiffness, but they should never be used for transport purposes. The Thomas splint with plaster or glue extension is the ideal transport splint, and fractures of the femur such as we meet with in civil life can be most adequately dealt with by this apparatus in its simplest form. The stiffness of the knee which follows retention is of a very transient kind and is usually quite overcome after two weeks' massage and exercise. As a transport splint in civil life, it is ideal. On several occasions in bygone days when I assisted H. O. Thomas, I remember workmen being brought to him with fractured thighs. In a few minutes, without an anæsthetic, a splint was applied and the patient sent home often a considerable distance in a four-wheeled car.

The lessons that we civilian surgeons should learn from all this are clear. If such results are obtained by simple means in such compound fractures as have occurred in war, why should we have recourse to more complicated methods? Why should the student be taught that fractures of the femur can only be adequately dealt with by plates and screws or other internal splinting? Why should we spend so much ingenuity and time in devising operative novelties, when it is so much easier and useful to learn the simple way? In the hands of the expert and cleanly surgeon catastrophies may generally be avoided, but what of the rest? In every village and hamlet the humblest of us may be called to treat a broken thigh, and the humblest of us should know before he leaves his studies how this can be done with safety and success.

Many years ago, I pointed out that the textbook deceived us as to the time it takes for bone to consolidate sufficiently to bear body-weight. This delay in solidification is still more pronounced in war wounds. After several months of apparent union, angulation may occur unless the bone is protected. The use of the caliper splint is the best protection. This splint is a Thomas splint running into the heel of the boot, and it should be used in the later stages of treatment of all fractured femurs. The removal of the splint should be gradual, and the experiment should be made under careful observation.

Time will only allow me to touch upon a few of the many interesting surgical problems that we have worked among. We have found loss of substance the most common cause of non-union. This is more especially the case in the humerus and the femur. When there is another bone to maintain the length, non-union is less common. Esquillectomy, though at times inevitable, accounts for many of these gaps which do not fill up. It is quite impossible at the time of injury to say that a loose piece of bone has no blood supply. In the later stages of treatment we have been often impressed by the osteogenetic power of apparently loose pieces of bone, which have lived in suppurative areas. This has led us to advise the maintenance of the length of limb rather than to approximate the bone ends, more especially in the case of the femur. Gaps which on X-ray examination only exhibit a faint shadow here and there may ultimately be filled up with bone. Ununited fractures of the femur with loss of bone should be kept in caliper splints and allowed to wall-

with rubber tubes above and below the fracture. This, apart from maintaining the patient's health, increases local congestion and osteogenesis. Many ununited fractures of the humerus have been caused by prolonged and too powerful extension, and sometimes by the injudicious use of the Thomas arm splint. The Thomas arm splint is essentially a transport splint, and its prolonged use may give rise not only to non-union but also to ankylosed elbow, wrist and fingers. Compound fractures of the humerus is best treated with the arm abducted. Ununited fracture of the humerus is most surely united by the step cut operation, and the steps should be long. Shortening of the arm is of minor importance. Bone grafting proved of no appreciable value in filling gaps in the shaft of the femur or the humerus. Real adequate development rarely if ever was secured even if the graft lived. Several grafts which have been used to make up the deficiency in flail joints have fractured, and in the few that have survived for over a year there is but little promise of adequate stability. The best results from bone grafting are in association with the radius and ulna and the tibia so long as the fibula is intact, and I think that the method described by Hey Groves is best whereby the ends of the bone are freshened, their medullary cavity drilled, and a piece of tibia like a cricket ball is removed and the two sharpened ends are passed into the medulla. This technique is suited to non-union in association with a gap. If bone grafting is decided upon it should be done in two stages, the first being the removal of scar tissue. This allows of better blood supply to the graft and lessens the liability of sepsis. In malunited fractures we never operate in the presence of a sinus nor for some months after it has closed. We hasten the healing by a free exsection of sinus, scar and bone. If the alignment of the bone is good and the shortening does not exceed 1.5 inches we do not operate. If the alignment is good but there is marked rotation of the limb, we perform an osteotomy some distance from the fracture. In malunion we rarely evacuate the ends of the bone through the wound, but prefer to follow the attached surfaces with a chisel and trust to extension without internal splinting. Rough manipulation stirs up all hostile factors. We should be merely gently efficient. Although we know fractures will unite in the presence of sepsis, the sooner we eradicate sepsis, the firmer and better will union become. In recent and in ancient fractures all joints should be kept mobile, and the muscles should be regularly stimulated by electrotherapy.

RESTORATION OF FUNCTION IN JOINTS

The restoration of function in joints is too vast a subject to dwell upon. Suffice it to say that forcible movements are rarely indicated. Certain symptoms following manipulation and passive movements indicating injurious strain may be formulated.

If pain occurs after manipulation and is of short duration, movements may be continued.

If pain persists for lengthy periods after manipulation *rest* is indicated.

If the increased range of movement is maintained after manipulation further movements can be safely prescribed.

If in spite of movements, even in the absence of great pain, the range is continually diminishing, rest is indicated.

The duration of pain when tissues are relaxed, rather than its intensity, should be our clinical guide.

In overcoming adhesions and in subsequent manipulations, the joint should be put through its various movements only once. The oft-repeated pump-handle movements applied at each sitting are never useful and often start inflammatory symptoms. Voluntary movements can safely be allowed and should be encouraged. They are not followed by obstructive reaction.

The treatment of intractable stiffness and ankylosis will not be dealt with in this address.

One of the common products of the results of war injuries is the flail joint. In other words, a pseudo-arthrosis which is of very imperfect function because the bones forming it do not come in contact and, in consequence, the lever is imperfect because it has no fulcrum. The greater number of these disabilities are the direct results of excisions deliberately performed at casualty clearing sta-

tions or base hospitals. They were performed in order to save the limb from amputation, or the patient from death by minimizing local sepsis and preventing general sepsis. Joints are difficult to drain, and the excision simplified the immediate problem. The only competent judges of the necessity of these measures were the surgeons at the front, upon whom rested so many grave responsibilities. It is our duty to recognize this, and to try to lay down suggestions for the immediate and later treatment of these loose joints in order to minimize the loss of function.

It is well, however, to realize that upon the type of resection, as judged from cases which have arrived at our centers largely depends good or bad function. Cases of so-called limited resection have resulted in better function than where the excision has been extensive. Furthermore, cases where the sepsis has been overcome and the bones allowed to remain in position have resulted sometimes in very good and firm ankylosis with excellent function if the position of election has been maintained. There is no reason why any joint should be allowed to heal at functional disadvantage. This, however, is even yet not sufficiently appreciated. One draws attention to this, not as a matter of adverse criticism, but in case one may be tempted sometimes to excise too much bone, or to forget that the functional defects following extensive excision may be minimized by correct after-treatment.

The flail joint may follow (a) as a direct result of excision; (b) the removal by the surgeon of large comminuted pieces of bone; (c) the direct loss of bone from missile; (d) the extrusion of necrosed bone during sepsis.

In order to preserve function (a) the extent of excision should be strictly limited subject only to conditions of safety; (b) the extension applied should be very moderate and of short duration; (c) in the after-treatment ankylosis should be aimed at rather than mobility.

a. The limitation of extent of excision is very important. Muscular attachments which have important influence in maintaining good function should be spared where possible. The tuberosities of the humerus; the nerve supply of the deltoid; the condylar attachments of the muscles governing the elbow; the triceps expansion; the biceps insertion; the coronoid and, if possible, the whole or a portion of the olecranon should be preserved. Again, one should endeavor to retain as much width of the lower end of the humerus as is possible, in order to allow the surgeon to restore leverage later.

If it is impossible to leave the important muscular attachments *in situ*, it may be possible to chisel off the portion of bones to which the muscles are inserted, such as the olecranon, tubercle of radius, coronoid process and the tuberosities of the humerus. They may all be useful later for reconstructive purposes.

b. We should strictly limit extension both in extent and time. I have seen several cases where this was not done and where after excision of elbow, a Thomas arm splint has been applied for three months and more with separation of the joint surfaces for many inches. The extension should be strictly limited to the urgent needs of drainage. Strong extension of a limb where the joint has been excised obstructs free drainage. The extension, if necessary at all, should be of the lightest kind, and maintained for the shortest period possible. An abducted shoulder and a flexed elbow admit of excellent drainage. In the case of the shoulder and of the elbow, the dependent position of the arm and forearm permits of purulent tracking down the muscular planes.

c. Again the rule should be *to aim for ankylosis* in the best functional position. We need not here enter into the arguments for and against mobility. The fact that we aim for ankylosis does not mean we will attain it. We very rarely can, but the effort leaves us the best possible result for future reconstruction. The rule, therefore, should be that so soon as the surgeon can do so, he should place the bones as near together as he can, and in the best position for future function whether a pseudo-arthrosis or an ankylosis occurs.

TREATMENT OF THE FLAIL JOINT

The flail joint as we meet it is practically useless from the point of view of function,

and it demands mechanical or operative treatment or a combination of both.

Treatment may consist of (a) removal of necrotic bone and scar tissue; (b) correct posture; (c) operative attempts at improved pseudo-arthrosis; (d) production of ankylosis; and (e) retention in mechanical apparatus.

a. A fair proportion of flail joints, especially the shoulder is complicated by infected bone and is discharging. Where it is possible these cases should be treated like osteomyelitis elsewhere, i. e., by excision of sinuses, scars, and infected bone. Whether operated upon or not, the bone surfaces should be approximated and retained in the functional position. A surprising proportion of cases take in their slack and ankylose, or result in a much firmer pseudo-arthrosis.

The shoulder and elbow are the joints most responsive to this treatment.

b. Where all wounds are healed, the shoulder should be placed in the functional position either by means of an abduction splint or an angular elbow-splint, or in plaster. The latter method lends itself very well to these two joints and gives the much needed stability. The bones should be insinuated into juxtaposition to each other without crumpling the soft tissue between them. The fixation should be maintained without an interval for at least three months.

If the muscles governing the joint retain power, the after-treatment must be carefully conducted. In the shoulder the upper portion of the plaster support should be removed so that the arm rests on the gutter-shaped, under part of the cast. Liberty should be allowed the patient to exercise his deltoid, and when he can lift it slightly from the splint, the arm can be brought a little nearer to the side and the angle of the abduction splint, lessened, when a larger range of movement may be allowed the scapula and humerus. From time to time the arm is still further lowered until it can be safely dropped to the side. If the pseudo-arthrosis is bony or short fibrous, the shoulder blade becomes the joint. If there is free mobility the deltoid may be trained to lift the arm. This it does by raising the lower fragment and drawing it against the axilla with quite a useful functioning joint. The elbow-joint, when the arm is removed from the sling, should be more acutely flexed and the forearm slung by the wrist in order to strengthen the biceps and brachialis anticus. As these muscles gain in power, the forearm can be gradually lowered until it reaches a right angle. For a considerable time it should be kept from further extending in order to retain and increase the power gained by the flexor muscles. Such shoulders and elbows, however, are always weak, and in the elbow a considerable lateral instability results. A hinged splint gripping the elbow with a shoulder cap will be of advantage in the case of the unstable elbow.

c. Attempts may be made at improving the stability and retaining the mobility of weak pseudo-arthrosis by operation. This should only be attempted where the muscles governing the joints may be reasonably expected to recover strength. The operation consists in removal of intervening scar tissue and bringing the bones into closer contact. They may be kept together by means of kangaroo tendon or other absorbable material.

d. Ankylosis of the flail joint, often a difficult matter, will be discussed in relation to the joints involved.

In the case of the *hip*, if the femur has merely been deprived of the head and neck, all that is needed is to correct any deformity which obstructs walking, such as abduction. This can be done by division of the adductors. If the limb cannot bear weight a jointed caliper, that is a caliper allowing flexion at the knee, should be applied. This supplies an artificial lever, and the muscles governing flexion are enabled to resume their function. With such a splint the patient can walk long distances with ease and strength. When the trochanter and part of the shaft are also lost, again this splint proves very useful. Bone grafting, as usually understood, is of very limited application in the upper part of the shaft of the femur. Ankylosis in the case of limited excision of the hip is of no advantage, and certainly does not justify the severe operation which it would necessarily entail. If the trochanter and part of the shaft are removed, the most likely method of obtaining

an ankylosis is to take a long strip of femur half its thickness, and slide it into a prepared acetabulum. The slide should rest for two or three inches in the groove of the femur. Such a graft has a much better chance of life than when introduced from another part of the body. A thin graft removed from elsewhere never develops strength in the adult and will refracture. Mechanical measures, however, should be adopted in place of operation whenever possible.

Ankylosis of the joint is the only practical treatment for the flail *knee*, and if the bones are in good position, nothing is needed excepting to saw the ends and fix them with screw or nail. If there is a wide separation, however, and the ends have been associated with sinuses, union is not easily secured. In such a case it will be necessary, after sawing the ends of the bone, to bring a bulky, sliding graft from tibia or femur and wedge it in at right angles to the line of the joint. This is a method I have often employed in secondary excisions in pre-war days where union after excision has not been firm.

If there is shortening to the extent of many inches, the patient may prefer an artificial limb, and he may supply arguments worthy the surgeon's consideration.

If an operation is refused, the caliper splint and a high boot will afford the best help.

A flail *ankle* is so rare that I cannot recall an instance as the result of a war wound. Should it be met with, the treatment will lie between an ankylosis or an amputation.

I have already described the postural treatment we should adopt in the case of a flail *shoulder-joint*, and I have stated that a successful pseudo-arthrosis is very difficult to secure. In a limited number of cases where the head of the bone only has been removed, and where the muscles attached to the tuberosities and the deltoid are functioning, abduction and carefully conducted muscle reeducation may result in a joint preferred by some people to an ankylosis. The very flail joint can only be approached with confidence if an ankylosis be aimed at. I have seen certain cases where bone grafts have been introduced to lengthen the shaft, with results which have at first appeared promising. I have also seen these cases with their grafts refractured and never to unite again, and others which have been absorbed leaving the patient in a worse plight than before. The result of my experience is that I would prefer adopting a more certain route, such as the production of ankylosis by end-to-end apposition.

Many operations for fixing the shoulder have failed because the surgeon has been content to bare the glenoid and freshen the humerus. This is usually quite insufficient. If the deltoid has been hopelessly deprived of function, an excellent exposure can be obtained by turning back a flap of skin and exposing the upper part of the deltoid. This muscle can then be cut across or reflected upward as a flap. The joint should be fully exposed, and the glenoid gouged as deeply as possible. The base of the coracoid and the acromion should be chiseled, and the bony flaps left attached. The upper part of the humerus is then exposed and sawed through, and a groove made into the upper part of the shaft for the reception of the acromion. The humerus is pushed into the glenoid and the acromion sawn partially through and pressed into the groove prepared for it. The glenoid, humerus, and acromion should be fixed in contact by kangaroo tendon and the arm placed in the functional position. Major Naughton Dunn has pointed out to me that if there be much shortening of the humerus the functional position will vary from that which I advocated at the beginning of the war. If there is no loss of bone the position of selection is just in front of the coronal plane of the body, while if there is much loss of bone it will be necessary to fix it in a plane posterior to this. Otherwise, in flexion of the elbow the hand will pass beyond the mouth. It is advisable before fixing the shoulder to test the position by flexing the elbow and observing the relation of the hand to the mouth.

Before an arm is ankylosed, care should be taken to ascertain whether the scapula is mobile, also whether it retains its normal position in regard to the humerus. This is extremely important. The success of the operation depends on sound ankylosis *and a*

mobile scapula. If the scapula is fixed and the arm abducted the result of the operation is a tragedy, for the patient will have a fixed abducted shoulder with an arm he cannot lower. I have seen several such results.

After operation great care should be taken to exercise and re-educate the scapular muscles. The range of scapular movement in the young soldier increases for many months.

Two methods of treatment for flail *elbow* are available here: (a) the non-operative, (b) the operative.

The non-operative method consists of the approximation of the bone ends, counteracting the effect of gravity, and in muscle re-education and development. It also often involves the wearing of apparatus.

The operative treatment has one of two ends: (a) the formation of a bony ankylosis, (b) the provision of a mobile arm with stability.

How can we fix upon the type which should be operated upon and that where it is best not to operate.

The *non-operative* treatment is only likely to be successful where the bone ends are broad.

If the bone ends are pointed and distant, non-operative treatment cannot be successful even with good muscular control. Many surgeons have described how difficult it is to obtain union in flail elbows. Failure is probably due to a technique which trusts too much to limited surfaces of attachment.

There is so little vitality in the ends of the bones that a mere freshening with apposition and fixation will often fail to accomplish union. When nails are driven in the result is no better, and further interference with blood supply is the result. Operation must be designed whereby a larger apposition of raw surface is secured. This can be effected by splitting and reflecting the ends of the bones, and in this way widening them.

Time will not allow me to describe any of the many operations which we have adopted. From the nature of the bone ends no one routine operation can be prescribed. The principle in all is the same: freshen the bone ends, splint them without detaching the fragments, enlarge the area of bone apposition, and firmly immobilize.

Pseudo-arthrosis of the elbow. We need not now discuss pseudo-arthrosis of the elbow when this operation is performed for mobilizing an *ankylosis.* It is a different proposition when we wish to stabilize a flail joint and yet permit of voluntary movement. A necessary condition to the success of this operation is a sound muscular control. If this is not present it should never be performed.

The object of such an operation is to approximate the bone ends; to transform the lower end of the humerus into a wedge which is received into a V-shaped slot prepared in the upper ends of radius and ulna, fascia is intervened, the bones are fixed by kangaroo tendon, passive movements are started early. The shape of the incision into the bones makes for lateral stability. In attempting to *produce* ankylosis of flail joints we often succeed in producing a satisfactory pseudo arthrosis; when we directly aim at a pseudo-arthrosis we are in danger of losing stability.

Time will not permit me to deal with stiff and ankylosed joints. I will only say that many pre-war methods have had to be discarded. War has taught us to avoid the methods of force in favor of the persuasive and the gentle.

SUMMARY

The war has taught us that a more systematic and thorough education is required in the treatment of fractures. This can only be effected either by setting apart wards for fractures under the care of men who devote real interest to the subject, or by retaining certain institutions solely for the treatment of these cases. Education is sure to be imperfect if the treatment of fractures is to remain in the hands of surgeons who take no interest. We should regard every fracture as the potential cause of disability. In England, and I should imagine to a certain extent here, the demands for beds is so pressing in our civil hospitals that a junior officer will gain no favor if fractures are admitted in numbers or are retained for long. This, after all, is only a repetition of the story of early evacuation in time of war. It has no justification in time of peace. If general hospitals are not

prepared to segregate cases of fracture, properly superintend them, and to treat them until evacuation is safe, they are far better without them, from the point of view of the surgeon and the student, and of the unfortunate victim.

Your nation taught us a valuable lesson when a committee was appointed to standardize splints, and all the surgeons were taught to master their construction and use. This again should be of value in civil life. If the simplest and best splints were standardized by a committee of experts, and their application thoroughly taught to every student it would clarify a complex problem. The student should be taught not to be out and out adherent to an operative, a fixation or a mobilizing school. He should be taught to cultivate a sense of proportion, and above all he should be taught how to make a diagnosis without first consulting an X-ray picture.

War has taught us the importance of insisting that before a man becomes a specialist he should have a sound working knowledge of general surgery. Nothing is so fatal to progress in any special branch than when, from defect of education, a surgeon is obliged to take a microscopic rather than a telescopic view of a problem. When a firm surgical foundation is acquired, he can deflect his energies with great advantage to special fields. One of the inevitable misfortunes of the war has been that able young surgeons with but little pre-war experience have graduated as excellent operators. They should, on their return, supplement their knowledge of the use of the knife by a careful study of conservative methods such as they will find in our reconstructive hospitals. The scalpel is not the surgeon's greatest asset, it may be his greatest curse. He requires a steady head even more than a steady hand. We must in future give him more liberty of action, make more use of him than we have been accustomed to in the past. His flexible mind has great potentialities. This can only be developed by giving him a fuller responsibility. It is a tragedy to see men between thirty and forty gathering the crumbs that fall from the table of Dives. The experience of age is after all only the product of opportunity. Let the young glean all that is worth gleaning from their seniors, but let us on our part offer the hand of friendship to all who strive to improve upon our methods, and value their loyalty all the more if they maintain a critical spirit.

War has done us one supreme service. It has cemented the two nations we love into a sacred bond of brotherhood. May it last in ever increasing strength throughout the ages.

CARE OF THE WOUNDED MAN IN WAR[1]

By SIR ANTHONY BOWLBY, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., London, England

THE great war has finished. The storm that shook the whole world is over, although its waves still break on many shores. The ships of state of the Allies have weathered the tempest and now lie in harbor to repair and refit. The time is ripe to take to heart the lessons we have learned, and to see that we have profited by our experiences.

It is almost a truism that the Armies and Navies of all the combatants have relied as never before on the labors of the whole civil population, and that every branch of science has been called upon to contribute in response to the call of "the country in danger." But what interests us here and now is not so wide a range of subjects as this consideration suggests, and I propose to ask you today to fix your attention on one subject alone — "*The wounded man and his wounds.*"

During the past years of war men killed in battle have been counted by the million, and men wounded by tens of millions. Never before have surgeons had to treat such vast numbers of human beings. But in dealing with a war which has raged in some part at least of every continent, except on that of America, it is evident that attention must be concentrated on some one region alone, and consequently I must perforce leave to others the campaigns in most of the theaters of war and must limit myself to the one area personally known to myself and to many of you, namely, France and Belgium.

In this area four Great Powers have shared the fortunes of war against Germany and it is not too much to say that in this area the surgeons of these powers have contributed very largely to the success which the Allies have achieved. Belgium, France, the United States, and Great Britain with the Dominions have sent many of their best to this "Western Front," and the world at large has the right to expect that it will profit by the collaboration and free interchange of ideas which have so happily characterized all our work.

But if I am asked whether this expectation of benefit has been justified, I have no hesitation in replying that far more has been learned than anyone could ever have dared to prophesy before the war. In the first place the whole practice of military surgery has been revolutionized with the cordial cooperation of the Army Medical Services, and opportunities for the thorough and appropriate treatment of wounded men, both at the front and at the base, have been provided by the military authorities, such as in 1914 would never have been granted in the army of any belligerent. The whole standard of treatment has been raised, and, whereas in the early days it was a sufficient answer to any proposal to say — "You cannot expect to treat wounds in war as you would treat them in peace" —it is now fully realized that this is exactly what you should expect and should aim at, even if you cannot always attain your ideals. I have myself constantly pointed out that, apart from motives of humanity, it pays the army and the country to care for the wounded as well as possible; it pays the army by returning men fit and able to fight, and it pays the country in saving the pensions of widows and orphans and maimed soldiers. In days when the British army was sorely tried in 1918, for want of sufficient men, it was a source of very legitimate satisfaction to the Army Medical Service that our convalescent-camps for the sick and wounded in France supplied a never-failing stream of soldiers returning to their regiments. And, as to mortality, I found on April 15, 1918, that the wounded admitted to Etaples and Camiers during our very worst week of the whole war, i.e., from March 22 to March 29, had done so well that at the end of three weeks the total mortality in nearly twenty thousand wounded men in this area was only one per cent. In the ensuing summer it was nearer a half per cent. What is the explanation of these good results? The answer is to be found in the methods we had learned for

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treating the wounded man and his wounds, for no such results were obtained in the army of any belligerent in 1914-15.

It will be universally acknowledged that the first and most striking danger to the man wounded in war is "shock," and this condition is met with in a far higher percentage of men wounded in war than in those correspondingly injured in the occupations of peace. The reasons for this are sufficiently obvious, for the man injured in the workshop or the factory or on the railroad is not suffering from want of sleep or want of food and of water. He is not unduly exhausted by physical strain or by mental excitement, and when he is injured help is at hand quickly.

The man injured in war is frequently suffering from some or all of these causes of exhaustion, and he is often thoroughly chilled after his injury through lying out in cold, wet, or even freezing weather. The "shock" of the soldier is, as a result, often quite out of proportion to the severity of his wounds, and is consequently not to be estimated accurately as true "wound shock" until these other factors have been eliminated by appropriate treatment. Unless this is kept in mind it becomes exceedingly difficult to estimate the true value of remedial measures, for it will be found in war that complete rest, plenty of hot drinks, and plenty of warmth will in thousands of cases restore, in a comparatively few hours, men who were cold and pulseless on admission to hospital. I have always been convinced that the most important of all the remedies for shock is warmth, and that nothing takes its place. The consequence in France was that when this was appreciated, and when every casualty clearing station had arrangements for warming men by the introduction of hot air under the blankets, the majority of the badly shocked men went to sleep after a good drink, and recovered with surprising rapidity.

The men who did not respond to these measures were those who were suffering from true "wound shock," and it must be constantly kept in mind that the injury inflicted by rough transport may be as potent a cause of true wound shock as was the original gunshot wound itself. It is, therefore, obvious that if this statement is as true as I believe it to be, much of the wound shock can be obviated by sufficient care in the early application of suitable splints, which should be employed in all severe injuries and not reserved for fracture cases alone, and also by the supply of well hung and well warmed ambulance cars.

It was partly by such simple and accessible methods as these that the condition of the wounded man was so greatly improved during the war, and it will be by the application in civil life of the knowledge we have gained that a like improvement will be obtained in peace.

I have been myself so convinced of the importance of care in the transport of injured men that, with the aid of the Army Medical Service and of the British Red Cross Society, I have arranged for the equipment with suitable splints of 500 motor ambulances in various parts of Great Britain, and arrangements are now being made to see that the ambulance drivers and the orderlies are as thoroughly trained in the use of the "Thomas outfit" for fractured extremities as were our orderlies at the front in France. I suggest to you that you will find similar measures of incalculable value to men injured far from surgical help in your own great country, in lumber or mining camps, or in remote farms and villages. It is quite easy to train men who have no surgical knowledge at all so that they shall provisionally put up a fractured leg or thigh much better than the best surgeon could have done it before the war, and I believe that one result of what our experience has taught us is that in every country arrangements should be made to teach how badly wounded men may be taken even for great distances without further injury being inflicted upon them by the transit.

But although so much may be done to prevent shock it must be recognized by everyone that shock and death from shock have been terribly common occurrences; and surgeons and physiologists have in large numbers availed themselves very fully of the innumerable opportunities afforded for increasing our knowledge of its pathology and treatment. It is not possible even to mention the names of all the leaders in this enquiry, but Crile and

Cannon in the American Army, and Cowell, Fraser, Keith, Drummond, and Wallace in the British Army cannot be omitted, while the experiments of Bayliss and Dale have thrown much new light on the various physiological problems.

I will not attempt to discuss the various opinions and views of the many workers in this field, but will ask you to allow me to place before you what seem to me to be the chief facts we have learned.

1. Wound shock may immediately follow a wound — "primary shock" — or may be delayed for even some hours — "secondary shock."

2. The total volume of blood in circulation is diminished, while at the same time the blood becomes concentrated — unless there has been severe hæmorrhage.

3. The loss of blood from the circulation is due either to its accumulation in the capillary area or else to the transit of its serum through the wall of the vessel—probably the latter.

4. Blood pressure is greatly reduced in proportion to the severity of the shock (or of serious hæmorrhage).

5. If a blood pressure below 60 millimeters of mercury, or a blood volume of less that 65 per cent continues for more than a very few hours, all remedial measures are useless.

6. Great loss of blood causes conditions and symptoms closely allied to those of shock.

7. Most of the symptoms and circulatory phenomena which characterize shock may be produced by toxæmias of various kinds.

8. It is probable that auto-intoxication from the products of devitalized and crushed muscle may also cause similar symptoms in some cases.

The practical deduction which is to be drawn from the consideration of our present knowledge of shock is that, inasmuch as the principal phenomena are loss of blood volume and fall of blood pressure, the obvious aim should be to restore these.

Treatment by rest, warmth, and taking of fluids is indicated in all cases, whatever more may be required, and morphia in moderate doses will be useful in allaying pain, anxiety, and excitement, and so encouraging sleep. In many cases nothing more is needed. The simplest method of increasing the blood volume is to administer fluids by the mouth, and, as all soldiers in battle areas have only limited supplies of water to drink, it should be accepted as an axiom that all wounded men always require drink as soon as they arrive at an aid post or field ambulance.

Unfortunately, many patients with really severe shock are quite unable to keep down any fluid, and in that case rectal injections are often most useful, especially when the patient has lost much blood. I believe it is true that both blood pressure and blood volume are more likely to remain improved by gastric or rectal absorption of fluid than by the intravenous administration of the same quantity. It seems clear that the direct addition of fluids to the venous blood is not so good as the making of blood serum by the patient himself from fluid absorbed through a mucous membrane. But in many cases of severe shock and in view of the fact that delay may mean disaster, it is often necessary to perform intravenous infusion as soon as the patient has been warmed and rested. We have learned that normal saline is useless for this purpose, but it is the opinion of most observers (and it is mine) that Bayliss' solutions of 6 per cent gum arabic in normal saline is of the greatest benefit in raising the blood pressure for long enough to carry the patient over the danger period.

In proportion as the shock conditions are due to excessive bleeding, infusion of blood is better than gum solution and is undoubtedly indicated; and not less than a pint should be introduced.

There is no doubt that many lives were saved by this practice, and there is also no doubt that it was not until the surgeons of the United States Army joined the British Casualty Clearing Stations in 1917, that blood transfusion became common. Its employment was subsequently utilized yet further forward, and great benefit ensued when prepared, citrated blood was sent up to the field ambulances when a battle was impending during the advance of the Allies

in 1918, for it could safely be kept for from 12 to 18 hours or more before use. I would suggest that in future sterilized gum solution should be kept ready for use by operating surgeons and by all hospitals, and also that test sera for donors of blood should be regularly stocked, so that no delay may arise in the choice of a donor for blood transfusion, for, if such treatment is necessary at all, it is certain that there will be no time to waste, as the experience of war has shown that if blood is transfused too late it is quite useless.

But if we learned much that is valuable about shock and its prevention and treatment we must realize that, after the patient had been pulled through the shock period with difficulty, it was often necessary to operate as soon as possible, and before sepsis had appeared upon the scene; so that no sooner had the patient been saved from the shock of his original injury than he was obliged to run the risk of operation shock. Still, where limbs were hopelessly shattered, or main vessels were torn, or the abdomen was shot through, etc., there was no choice left to the surgeon, who also knew that in many cases the rapid removal of a smashed limb resulted in great relief of symptoms.

But operation generally meant anæsthetics and here we were destined to learn a great deal that was new to us.

With regard to the choice of an anæsthetic agent it may be conceded at once that for all slight operations on patients in good condition "open ether" is very often quite satisfactory. But when in wintry or wet weather very many of the wounded were already suffering from a bronchial catarrh, ether was very liable to cause grave pulmonary complications, and it was not until we introduced the "Shipway apparatus" for warming the ether vapor that it could be safely administered in such cases. I would very strongly advocate that, in the future, warm ether vapor should be systematically employed as the best routine method where ether is used in civil practice, for it is not only less irritating to the lungs, it is also much less liable to cause severe vomiting.

But in cases of "shock" neither chloroform nor ether is safe, for a careful record of blood pressure during operations under ether by Major Geoffrey Marshall showed conclusively that although the blood pressure might be high when the operation was finished this was soon followed by a reactionary fall and death in very many cases.

And not only is ether not a safe anæsthetic in shock, it is also very injurious if, as is so often the case, it causes nausea and sickness in men who need every ounce of fluid nourishment that can be given, for this sickness if continued for some hours will destroy the last chance of recovery of the shocked man.

Much had been expected from the intrathecal use of stovaine, but the sudden fall of blood pressure it caused proved to be very dangerous in shock, and local anæsthesia was so tedious that it was not possible to use it in many cases when patients were very numerous. There remained nitrous oxide and oxygen. The value of this agent in shock had been conclusively proved by Marshall in 1916, and his observations showed that under its influence extensive operations could be performed without any *immediate or subsequent* fall of blood pressure, but it was not until the "teams" of the United States surgeons came up for the Passchendaele fight with plenty of nitrous oxide and oxygen that it was administered on a large enough scale by first rate anæsthetists. Its use saved many lives, and in abdominal operations the very best results of all were obtained by combining it with infiltrative anæsthesia of the abdominal wall. By this combined method the gas and oxygen required was reduced to a minimum, and the operator was not troubled by abdominal rigidity. It was by the use of this combination that Majors D. Taylor and G. Marshall at "Rémy siding" succeeded in saving 74 patients in a consecutive series of 101 operations for perforating wounds of the abdomen, and I believe that these results were the best obtained in the British Army during the war.

Very much more might be said of war anæsthesia did time permit, but I would urge that gas and oxygen should be supplied together with suitable apparatus for all the Army Medical Services of the future, and I would also press upon your attention the value of *warm* ether vapor in the prevention

of pulmonary complications. May I add further that I believe that the combination of gas and oxygen with local anæsthesia is the very best anæsthetic agent for most of the abdominal operations of civil life, and for many others also, for it causes no fall of blood pressure, it eliminates anæsthetic shock, and it abolishes postanæsthetic vomiting and all its attendant troubles. Now that more simple and safe apparatus has been invented by Dr. Gwathmey in your army and by Marshall and Boyle in ours I look to the time when no one will dread an anæsthetic or its effects. I will only add that I have seen a greater improvement in the use of anæsthetics during those years of the war than in all the preceding years of my surgical life, and also that in very many patients with completely smashed limbs it is often easy to complete the severance of the torn tissues and remove the shattered member without any anæsthetic at all.

THE TREATMENT OF FRACTURES

Let me ask you now to direct your attention for a few minutes to the treatment of fractures, for I think it is the opinion of all surgeons that here there have been great developments.

I will briefly sum up the position by saying that the fractures in France, both in your army and in ours, were treated by "extension and suspension," so that the circulation, nourishment, and mobility of the injured limb were maintained throughout as far as possible. Constriction by bandages has been reduced to a minimum, and limbs are no longer encased in wooden boxes or in plaster of Paris, and, as a result of the precautions to maintain in this way the vitality of the limb, wasting of muscles and stiffness of joints have been largely prevented.

It is greatly to be hoped that our war experiences will be utilized at home, and that all hospitals and medical schools will arrange for a much more systematic teaching of how to deal with fractured limbs, so that all young surgeons will in future realize that the so-called "setting" of the fracture should be really only the beginning and not the end of surgical treatment. And if this aim is to be achieved it will be necessary that some at least of the fracture cases in general hospitals shall be collected in "special fracture wards" equipped with the necessary apparatus for "extension and suspension," and supplied also with a mobile X-ray outfit, for there are many cases where a good result can only be obtained by frequent radiography.

Let it be fully realized that so long as the *principles* I have sketched are kept in view the details of how best to carry them into practice must be left to the skill and ingenuity of individual surgeons, and in view of the very many improvements which were daily developed by many young and keen surgeons in France, I would add: "Do not be too ready to standardize apparatus," for too early "standardization" is liable to spell "stagnation." Principles may remain while methods develop.

THE TREATMENT OF WOUNDS

Looking back to the beginning of the war it is evident that we had much to unlearn before we could learn, and there is no doubt that many of us in the British Army were too much under the influence of our South African experiences. Let me sum up these very briefly in order to try to see things as we saw them in 1914.

The South African War had been fought over a vast and very thinly populated country which was for the most part uncultivated, and whose thinly covered soil was so exposed to drying winds and burning sun that, as far as pyogenic organisms were concerned, it was practically sterile. The spore-bearing organisms of tetanus and gas gangrene were never encountered, and most of the wounds did not suppurate at all. Wounds from high explosive shells were practically unknown, and shrapnel bullets were few and far between.

There were no machine guns, and rifles were generally fired at ranges of over half a mile. The rifle bullet of both belligerents had an ovoidal shaped point, and was of an exact cylindrical form, so that it resembled a rather large trocar. The flight of these bullets was very steady, and unless they encountered a thick bone or were fired at extremely close range the damage they caused was strictly

limited to the tissues which bounded their track, and their entrance and exit wounds were alike minute. On six occasions I saw patients through whose patellæ one of these bullets had passed and had only left a hole which might have been made by a gimlet, the bone around being neither cracked nor fractured.

As a result then of the nature of the soil and the character of the projectiles the wounds we had to treat needed the minimum of surgery, and in the vast majority were best left alone to heal under a scab or blood clot. We expected something of the same kind of wounds in France, and were very rudely awakened before the war was many weeks old.

The fact was that in France everything was absolutely different as compared with South Africa. The country was thickly populated, the richly manured soil was swarming with all kinds of pathogenic organisms, enormous wounds caused by fragments of high-explosive shells abounded, and the rifle bullet was of a wedge-shape on longitudinal section, and so unstable in its flight that it was easily turned completely round by slight resistance and struck the tissues with its side or base. The consequence was that not only were the wounds highly infected by the soil, but that foreign bodies and clothing which was grossly contaminated by mud were to be found buried deep in the lacerated tissues. The wounds themselves were large and lacerated so that much of the exposed parts was partly or entirely devitalized by the smashing effect of the projectiles. Our previous experience turned out to be misleading, and we were soon swamped by tens of thousands of wounded men who developed gas gangrene and tetanus in great numbers.

It took time to get sufficient tetanus antitoxin, although the supplies from America saved many lives, but there was no antitoxin for gas gangrene, and at first we found no real remedy for it. Time and experience alone led us to the proper treatment by excision of all devitalized tissue and the careful and thorough mechanical cleansing of the wound; and it was during this period of learning and experimenting that antiseptics were given so thorough a trial, and were proved to be so valueless when employed in these grossly contaminated wounds.

The uselessness of attempting to sterilize an infected wound by the single application of a powerful chemical agent is really nothing new, and my friend Sir George Makins pointed out in his Hunterian oration of 1918 that Lister himself was quite aware of this, for he wrote: "If for example a pair of forceps is handed to the operator with the intervals between the teeth occupied by dry septic pus, and if a portion of this dirt becomes detached and left in the wound, the evil cannot be corrected by any antiseptic wash that is now at our disposal, or that the world is ever likely to see." Very striking words!

In spite of this dictum, however, some of the most eminent and famous of Lister's admirers in England were the most prominent in urging us in France to try to sterilize wounds by the early introduction of powerful antiseptic agents, and with the natural result that such measures were tried and absolutely failed. There is, indeed, now but one opinion among surgeons and bacteriologists who worked in France; namely, that *antiseptic agents are quite powerless to sterilize grossly infected wounds*, and I do not think it is necessary to impress this upon you, for your own observers have been unanimously in agreement with this view.

I have already said that the only real method of sterilizing the wounds of war as we saw them in France was by a suitable operation and the mechanical removal of all that might do harm, so that no tissue which is too badly damaged is left. The next question we had to decide was how to treat such a wound subsequently, and, as you are well aware, the answer was found in the "closure of the wound," by either "primary" or "delayed primary suture," except in those cases (1) where acute gas gangrene had already developed, or (2) where there had been long delay before the patient could be treated; or (3) where the infecting agent was a virulent streptococcus. The result was that we were able to suture within a few days, and subject to these conditions, from 70 to 85 per cent of all classes of wounds.

And we also learned very clearly both that

the results were not materially influenced by the use of any antiseptic agent and also that wounds could heal well and firmly even though they contained large numbers of micro-organisms, so long as the latter did not include virulent streptococci.

It soon became evident that the cells could destroy a considerable number of bacteria provided that the latter were surrounded by healthy living tissues and that by closure of the wound the advent of fresh infection was effectually prevented. The presence of bacteria of various kinds in wounds which nevertheless did well was recorded by observers of every nationality, and especially in the United States units by Crile, Kenneth Taylor and H. Cabot; and in the British units by Forbes Fraser, Adrian Stokes, McNee, and the workers in Almroth Wright's laboratory. In almost all regions of the body we closed wounds successfully, either by primary or secondary suture; in the head and neck, the limbs, the chest, the abdomen and the large joints, and we soon learned by experience that if patients could not be retained at the front after suffering from extensive wounds it was better to send them to the general hospitals with a packing of gauze, and let the wound be sutured without further interference after arrival. We found no advantage in using antiseptic substances with this packing, although many surgeons did employ flavine solutions or the bismuth iodoform and paraffin paste suggested by Rutherford Morison.

Much more might well be said as to details of treatment in different regions of the body were time no object, but the results obtained in the later stages of the war may be briefly summed up by saying that not only were many lives and limbs saved by wound closure, but that compound fractures healed more rapidly and with much less necrosis, joints were saved from acute arthritis, suppuration of wounds became rare, septic infection with its fever and emaciation diminished, and convalescence was infinitely more rapid. From the Army point of view, fewer beds were occupied, nurses and surgeons were spared much unnecessary work, and many soldiers were returned to their units fit and well within a few weeks instead of suffering for months from suppuration.

Surely it is evident that much of what we have learned is applicable to civil practice. Is it not certain that we shall close open wounds of the knee-joint, that drainage tubes will be much less employed, and that "delayed primary suture" will become a common method for the treatment of bad compound fractures and the lacerated wounds caused by machine accidents? The same method of wound closure by delayed suture will be found just as useful in amputations through tissues near to suppurating areas. We found it most helpful in the treatment of Syme's amputation, and Colonel Elder, when consulting surgeon at Rouen, showed me a very striking series of successful amputations by Syme's method performed upon natives of India for gangrene following frost bite, and treated by suture after an interval of three or four days. I believe that there is a wide field for the application of war methods to the treatment of the injuries of civil life, but I would emphasize that in suturing wounds after the interval of a day or two it is essential for success that *no further wound toilet is permissible*. The packing should merely be removed as gently as possible and the sutures inserted and tied.

There remains the question of the treatment of suppurating wounds. What have we learned of these? I think we have certainly learned two things: first, that it is more often possible to close them by suture than we had thought; and second, that Carrel's method is a very great improvement on the drainage tube and daily syringing.

With regard to the first: We found in France that very many wounds which were free from virulent streptococci could be successfully sutured even if they were suppurating, and Sir Berkeley Moynihan and Colonel J. Swain reported to the surgical conference in Paris that they had seen many cases of granulating wounds where satisfactory closure had followed suture combined with the use of the paraffin, iodoform, and bismuth paste. I have myself seen cases of similar successful closure of suppurating compound fractures in France, and Professor

Rutherford Morison and other surgeons have recorded many successes.

With regard to Carrel's method of treating suppurating wounds, I have no doubt at all that it has marked a very great advance. It supplies a thoroughly scientific and carefully thought out technique, and has been proved to be of the utmost value in the hands of many of the best French and Belgian surgeons as well as in British hospitals. I have seen admirable results from its careful employment, and I believe that where surgeons have had an unsatisfactory experience this has been largely due to an imperfect technique, for in many hands it has given admirable results in stopping sepsis and suppuration, and in enabling granulating wounds to be closed by secondary suture.

It is difficult to decide the rather academic question as to whether the method owes its success chiefly to the hyperchlorous solution of Carrel and Dehelly or to the method of irrigation, but I think myself that the method is more important than the particular solution.

Here again we have learned much that is useful in the treatment of the suppurations of civil surgery, for Carrel's method is not only valuable in the wounds of war, it is quite as efficacious in the treatment of an empyema or of pelvic suppuration. I have seen most excellent results from its use in large appendix abscesses on the one hand or in suppurating joints on the other, and I am convinced that it has supplied to the operating surgeon a valuable addition to his armament.

I cannot doubt that in the future the surgeon will also work more with the bacteriologist than he did before the war, for it has been by collaboration and experiment that many of our advances have been maintained without undue risk to our patients. And whatever we may have learned there is inevitably much more to learn in the near future. Let us all keep this in mind, and let us also remember that, as far as details are concerned, a too rigid standardization may be harmful. The only safe attitude is that we should be always inclined to believe that however good a method may be, it is always possible to evolve another which may be better still.

I have endeavored to point out to you in what I have said that the surgery of the immediate future may well be expected to benefit from our recent experiences; that we should improve our transport service and our first aid for the wounded in civil life; that shock can be better treated and can often be prevented; that anæsthesia can be rendered safer; that no antiseptic can sterilize infected wounds; that much more should be done for fractured limbs, that in delayed suture we have an important advance in surgical technique, and that suppurating wounds can be treated by improved methods. You are all well aware that were I able to consider in detail the surgery of the various regions, such as the head, the chest, the abdomen, etc., I should be able to record very many examples of advances in surgery, but this is not the occasion for such a discussion, and I am content to deal only with more general principles.

I cannot conclude this address without expressing to you my deep sense of the honor you have conferred upon me in appointing me to deliver it and in electing me to be an Honorary Fellow of your College. I had had but few opportunities of making the acquaintance of the surgeons of America before the war, but I have now the satisfaction of knowing that very many of them I can now call, not acquaintances, but friends.

When you came to France you came to our aid. When I was in the greatest difficulty in advising our Director-General how to arrange for the increasing demands of the surgery of the Front in the summer of 1917, my difficulties disappeared when I was able to secure your co-operation in our casualty clearing stations at the Third Battle of Ypres. I shall never forget the spirit in which you joined us there. Your one wish was to help us and our soldiers, and in so doing to learn to help your own troops later on. You were willing to sit at the feet of young "surgical specialists" of an age to be your pupils; you took your turns like the youngsters on night duty or in the reception rooms, in the resuscitation wards and the operating theaters. You were full of enthusiasm and most stimulating in discussing with us the surgical

problems of war. But more than all this — you sympathized with our soldiers in their troubles, our outlook was your outlook, and you worked hand in hand with us so that we became, like Nelson's captains, a real "band of brothers." Wherever I went during that prolonged and trying struggle toward Passchendaele I found that American, British, and Dominion surgeons had established a genuine appreciation of each other and of each other's work which will long outlast the war.

I shall never forget what you did, and in the name of the British soldier I thank you all for your help.

THE RELATION OF CANCER TO THE PROLONGATION OF HUMAN LIFE[1]

By W. J. MAYO, M.D., F.A.C.S., Rochester, Minnesota

INTRODUCTION

AMERICA is confronted by the problem of reconstruction following war. How may she best meet international competition along with failing immigration and an exodus of temporary residents who are now returning to their European homes with their savings earned in America? No one among us can be so mean of spirit as to desire the American laborer to return to pre-war conditions, but rather do we all desire that the laborer and his family shall be well housed, well clothed, well fed, and that his children, the future American citizens, shall be well educated and equal to grappling with the problems of their time. By laborers I mean all those high or low who are engaged in productive employment; not only men but women who, under changing conditions in this country, have become an important part of the labor supply. America must compete in international trade with countries which, devastated by war, contain peoples willing to work long hours for small pay, under labor conditions which we hope never again to see in this country. Successful competition demands efficient production.

There must be a reduction in this country of the 200 per cent unproductive man to a minimum. Every person who is fulfilling an unnecessary function between production and consumption is a double liability, inasmuch as the labor of another is required to maintain him, and what he might produce were he profitably employed is lost. This parasitic class is a great cause of social unrest in America.

THE RELATION OF MEDICINE TO THE PROLONGATION OF HUMAN LIFE

In the work of the medical profession lies the best hope for the future. Since the close of the Civil War fifteen years have been added to the average length of human life. With present knowledge and present conditions, fifteen years more might be added to the life of man in this country within the next twenty years. It is certain that ten years will be added, at the most productive age from the standpoint of industry, and will greatly aid in maintaining our position as the most productive nation. When I was a boy it was difficult for a man of forty to find a new job, and for a man of fifty it was practically impossible. Today the older men are great assets to the country. In the prolongation of their lives, their skill and experience in their particular work count for much. They are less inflammable, they have family ties and responsibilities—they have something to lose—so that they are less under the influence of the violent agitator. If, as a nation, we advance the time of production for each person ten years, we can well afford to shorten hours of work and improve living conditions, and we shall be able to compete with those countries in which long hours and poor living conditions shorten human life, and eventually decrease production and increase social unrest.

The introduction of potable water has made prohibition possible. Prohibition will enormously increase production. In Vienna the per capita consumption of spirituous and fermented liquors was reduced 40 per cent following the introduction of a pure water supply from the mountains. The failure of Italy and France to supply potable water necessitates the continuance of wine drinking, just as in Germany the use of beer will continue. If one traces the temperance movement through the states of the Union, he finds that it was not the appeal to the self-control of man which was behind this great movement, but the advent of potable water.

Alcoholic drinks loosen the inhibitory control which civilization has imposed over the primitive impulses of man. Crime, accidents, and social diseases too often have had their origin in the abeyance, through alcohol, of individual self-control. Pure water has eliminated typhoid; wholesome

[1]President's inaugural address, Clinical Congress of American College of Surgeons, New York City, October 20, 1919.

food and better living conditions which go with reduction of poverty will check tuberculosis, and better care of focal infections in the earlier decades will prevent many deaths in later life.

THE RELATION OF SURGERY TO THE PROLONGATION OF HUMAN LIFE

The arch enemy of middle age and beyond is cancer, and our measures both for prevention and cure have not advanced in proportion to the increasing need. One woman in eleven and one man in thirteen die with cancer and this proportion of cancer deaths will be maintained in the enormously greater number of persons who reach the cancer age. We must spread more widely the knowledge that chronic irritation is the great underlying cause of the disease. Whenever a certain type of cancer exists in a race of men or in a country with great frequency as compared with other races or countries, it is due to a single cause, usually a social custom. Good dentistry has eliminated a percentage of cancers of the jaw due to the irritation of defective teeth. Cancer of the lip and tongue is on the increase as the habit of smoking is on the increase in both sexes. It seems to be a well established fact that in the countries in which the breasts are allowed to remain exposed to the air without covering, cancer of the breast is extremely rare and the incidence is in direct ratio to the amount of covering of the breast and the pressure exerted on it.

Thirty per cent of all cancers in men and 21 per cent in women are in the stomach. The influence of drinks too hot to be held comfortably in the mouth in the production of the chronic irritation which precedes the development of gastric cancer seems probable. Unfortunately, we know less about the causes of cancer of the large intestine and rectum. Diligent search should be instituted to enable us, through knowledge of local causes, to reduce the number of such cases.

Operations for cancer. The majority of cancer patients come to operation too late to be cured. We cannot always demonstrate inoperability in a given case, and therefore operation must be done in many questionable cases to give the patient the benefit of the doubt. The mortality in the favorable cases, of resection of the stomach, for instance, is low, but some of the most extensive resections result in cures, although with a greatly increased risk. The paradox of increased experience accompanied by higher operative mortality and a smaller percentage of cures is seen; the explanation lies in the increased operability. The surgeon who reports only percentages of operative death rate and of cure without stating operability, gives us little information. We found that when we operated on only about 25 per cent of the patients with cancer of the large intestine and rectum, the mortality was about 8 per cent and the cures of the patients operated on about 50 per cent for a five-year period, but only 13 of the 100 patients were cured; 75 were considered hopeless at the time of examination and were not subjected to operation. Gradually the percentage of patients operated on was increased. The mortality advanced to an average of 12 per cent; the percentage of five-year cures dropped to 37 per cent, but we had 27, instead of 13 of the total 100 patients examined, alive at the end of five years.

I have been impressed with the fact that too little attention has been paid to traumatic transplantation of malignant cells during operation. Rough handling of the growth loosens cells which may become grafted on any surface denuded of its normal covering. A considerable percentage of adenocarcinomata of the ovary is due to spontaneous grafting of cells having their origin in cancer of the stomach. These cells are grafted on to the break in the ovarian surface due to the discharge of the ovum, and the secondary infection in the ovary, by rapidity of growth, may mask the primary disease. Transplantation may occur by gravity to the bottom of Douglas' pouch, the malignant cells becoming attached to the terminal epiploic tags. This produces the typical nodules so readily noted on rectal examination, and which make possible a diagnosis of metastatic carcinoma and inoperability even when the primary focus is unknown.

In our early cases of vaginal hysterectomy

for cancer of the cervix we rarely had a cure. The carcinomatous cervix was grasped with vulsellum forceps, traumatizing the tissues during the removal of the growth, and local recurrence resulted. We then began doing all vaginal hysterectomies with the cautery knife and many five-year cures were obtained. The cautery method has a field of usefulness in selected cases. We found that the excessive dilatation of the vagina, preliminary to the use of the cautery, made many fissures in the vaginal mucosa. In two of our cases carcinoma developed in these vaginal fissures from cells deposited there, although there was no recurrence at the site of the original neoplasm.

Carcinoma of one wall of the rectum, exercising eroding pressure on the opposite wall, may cause secondary growth. In carcinoma of the large intestine, by reverse peristalsis, carcinoma cells may be carried upward and become transplanted above as well as below the original growth. In one of our cases a preliminary colostomy was performed and at the end of two weeks, while there was still a little granulating surface around the colostomy wound, the rectum was removed from behind. Carcinoma cells were evidently detached, carried upward, and deposited on this prepared field, with the result that secondary carcinoma occurred, which was confined to the margin of the colostomy wound. Operative methods must be devised that will more effectively prevent cell transplantation as well as the traumatic detachment of cancer-infected thrombi into vascular channels—a complication which frequently causes postoperative metastatic carcinoma of the liver and lungs.

Radium, the X-ray, or the cautery as an aid to surgery in the treatment of cancer. The use of various agents to extend operability, prepare the cancer field for operation, and as after-treatment to reduce the percentage of recurrences, must be further considered.

The normal cell has three periods of existence: growth, function, and degeneration. The normal cell, in the first period, undergoes division for the purposes of growth. During the period of function reproduction is most active. The malignant cell has no period of function, its entire reproductive activity is thrown into the first stage, and only the embryonic growth cell is produced. The normal functioning cell as part of the community life is protected by the entire organism of which it is a part. The nervous system, the blood, the lymphatics, are all a part of this protective mechanism. The malignant cell has no such protection; it is five times as vulnerable as the normal cell and is treated by nature as a foreign body. Malignancy is the property of the cell; the stroma is not a part of the neoplasm but is the measure of nature's defense.

Malignant cells will sometimes be found encapsulated in the tissues of an operative field from which a malignant neoplasm has been removed. Occasionally through some agency such as traumatism or general disease the retaining wall breaks down, and metastasis occurs after many years of apparent operative cure. Radiotherapy destroys cells for a certain distance, but cells are sterilized at a greater distance so that their reproduction is checked, and connective tissue is caused to develop which acts as a barrier to the further extension of the malignant process. Radiotherapy often fails when malignant cells become attached to the walls of the three-coated blood-vessels from which they draw sufficient nourishment to withstand its effect.

Radio active substances give great promise for the future. I would include with radium and the X-ray, the radiant energy of heat. For some years the X-ray has been used more or less following operation and it is believed that the percentages of recurrences, for example in the skin, after operations for cancer of the breast have been materially reduced by this means. We have greatly extended the use of radium and have obtained good results in the last three years, especially in inoperable carcinoma of the large intestine and upper rectum. A colostomy is made as close as possible to the growth, and through it radium is introduced directly into the lumen of the carcinomatous area. In the stomach, by means of a Witzel gastrostomy and the introduction of a tube into the cancerous area, radium may be directly applied, and the

patient can be temporarily nourished by means of a jejunostomy.

Radium and X-ray are more or less selective in their action. Masses and bands of scar tissue are produced which delay the advance of the growth, but make subsequent late operation difficult and often ineffective. Heat is not selective, and the scar tissue resulting, while effective in preventing progress of the cancer, does not interfere so seriously with late secondary operative procedures. Radiotherapy has justly achieved a reputation in the postoperative treatment of cancer. It would appear, however, to have its greatest field of usefulness in preparing a malignant area against wound grafting during operation and its ability at least temporarily to reduce the vitality of the malignant cell. Radiotherapy whether applied as radium, X-ray, or heat, sickens malignant cells beyond the area of destruction. During this period of cell sickness their resistance is reduced and operation is most efficient, but operation should not be delayed after radiotherapy since the period of increased cell vulnerability is short and the connective-tissue development which interferes with subsequent operation is rapid. By properly combining radiotherapy with surgery, we can increase operability, lower mortality, and increase percentage of cures.

Suggestions concerning cancer research. It is probable that there is a measure of immunity against cancer in all persons, and that this is sufficiently great in some to prevent them from having cancer. I have on several occasions been unable to remove all of a cancerous growth and, to my astonishment, the patient has remained well for a term of years. A search for the cause of such immunity and a means of increasing it is greatly to be desired. The more primitive and important the function of an organ the greater its immunity. The two most primitive functions are the maintenance of the body and reproduction. The small intestine is primitive and seldom is the seat of new-growth; the large intestine has a short heredity and is a frequent seat of neoplasm. The testicle is primitive and is seldom the seat of neoplasms; the ovary is descended from the testicle, has a short heredity, and is a frequent seat of neoplasms.

The surgery of the past has been concerned largely with gross pathologic conditions. As our knowledge has increased diagnosis has improved, technique has advanced, and pathologic conditions are coming to operation much earlier. Surgery strives by every means within its power to reach pathologic processes before they have become gross, and the time is not far distant when treatment may, in some instances, be applied so early in the stage of deviation from the normal that surgery may be unnecessary.

Abstract sciences are being called to our aid, and scientific facts, apparently unrelated, are beginning to be understood in their relation to medicine. Much may be expected from bringing certain of the abstract sciences, especially physics, to aid biochemistry in giving us a better understanding of physiology and pathology.

In 1828 Brown, the botanist, pointed out that minute bodies of all kinds when suspended in gases and liquids are in constant motion. This movement of minute particles took the name of the Brownian movement. Thomas Graham, master of the mint in London, in 1861, called attention to colloids showing that they are matter in a special state of subdivision which makes each colloid particle an entity, but that except as to its physical state, the matter is unchanged. It has been shown that these colloid particles are endowed with movement and that while they are not visible they are of sufficient size to reflect rays of light, as seen in an ultramicroscope. The movements of the colloids Graham recognized as being the movements described by Brown. Physicists have now shown that all matter is in motion, and that those particles more finely dispersed than colloids have even more rapid motion, but since the tissues of the body are matter largely in a colloidal state, we are interested principally in this type of energy. In colloids there is energy, and when the colloid particles change into a less dispersed state, for instance when a cloud which is water dispersed in a colloidal state in the air gives forth rain, the contained energy of the colloid, if the change is sufficiently sudden, is shown as thunder and lightning. The tissues

of the body are in a colloidal state and retain their form and energy, while the non-colloidal elements of the blood, such as sugar and amino acids, diffuse through the tissues, furnishing food which is utilized by the tissue colloids after the manner of an internal combustion engine.

The biochemists have shown that when certain substances are in the colloidal state they are more toxic than when they are in other conditions, and this peculiarity has been attributed by some physicists to the energy contained in the colloid body. Certain substances in a colloid state are toxic, but in other states the same substances have no such property. An enzyme is believed to possess energy in part because of the great activity of its colloidal elements, and thereby to bring about chemical changes. It has been suggested that colloid represents energy in life, as radium represents energy in matter. The physical state of matter may influence those early changes which may result in cancer. The benign cystoid appendix, the escape of its colloidal contents from an aperture in the wall of the appendix into the peritoneal cavity, resulting in grafting of hypoblastic elements upon the peritoneum—pseudomyxomatous peritonitis, myxomatous peritonitis, colloid peritonitis, and eventually cancer — are a series of steps which are rather common examples of those processes which are related to the colloidal state. It might be assumed perhaps that the physical activity of colloidal particles attacks the tissues and prepares the field for grafting. Again it may change the nature of the disturbed mucous cells in the cystic contents of the appendix and thereby set in motion a series of events which result in cancer. Such changes are often seen in the ovary and not infrequently in the mucous surfaces of the large intestine and rectum or any part of the body.

Sir William Crookes, in his attempts to demonstrate the fourth state of matter, exhausted the air from a heavy glass bulb. When certain electric attachments were made, the bulb became filled with luminous matter, and, as Crookes expressed it, "actually touched the border land where matter and force seem to merge into one another." He named this luminous substance the cathode ray, composed of negative electrons, which is the fundamental conception of the X-ray. Crookes also pointed out that when X-rays come in contact with solid matter they give rise to shadows, and that the cathode rays, when outside a magnetic field, always travel in a straight line without regard to the position of the poles. The use of energy in the form of rays such as radium, X-ray, and heat are examples of biophysics in relation to medicine.

I have neither the time nor the knowledge which will permit me to delve extensively into the fields of biochemistry and biophysics. I wish rather to call attention to the contributions of the abstract sciences to cancer research and to urge more intensive study in these new fields.

THE SURGICAL TREATMENT OF EXOPHTHALMIC GOITER [1]

By GEORGE W. CRILE, M.D., F.A.C.S., Cleveland, Ohio

THE conclusions here presented as to the surgical treatment of exophthalmic goiter are based upon my personal experience in 2,250 thyroidectomies of which 1,169 were for exophthalmic goiter; among the latter 56 per cent of the cases, or 660, were ligated. No case was rejected for operation unless it was in the state of dissolution. In the last series of 331 thyroidectomies 116, or 35 per cent, were first ligated, and no case was rejected. Among the 116 ligations there was only one death, a patient in the early stage of dissolution, who was delirious when the ligation was made. The downward course of this case was not arrested. (Fig. 1.)

The series of 1,169 thyroidectomies for exophthalmic goiter began with operations under ether alone, and with no special precautions. The mortality rate of these early cases was 16 per cent. After the adoption of anociation—nitrous oxid-oxygen and local anæsthesia with the anæsthetization of the patient in his room—the mortality rate fluctuated between 2 and 5 per cent, until by the adoption of the system of management to be described the mortality rate for all goiters among the last 331 thyroidectomies has dropped to six-tenths of one (0.6) per cent. This number includes one series of 206 consecutive thyroidectomies without a death, and 182 thyroidectomies for exophthalmic goiter with two deaths—a mortality rate of 1.1 per cent. (Fig. 2.)

By the adoption of nitrous oxid-oxygen, the use of local anæsthesia, the multiple stage operation, the exclusion of the psychic factor, and the application of the principle of carrying the operation to the patient, it seemed as if we had included every possible means of safeguarding the patient. But we still lost an occasional case as a result of postoperative hyperthyroidism. In postoperative hyperthyroidism, the cause of death is excessive chemical activity. Therefore, the urgent need in these cases is a safe means by which this excessive chemical activity may be controlled. It is known that with each degree of rise in temperature, the chemical activity within the organism is increased 10 per cent; that is, if the temperature of a patient has risen to 106°, his metabolism has increased 70 per cent. Conversely, with each degree of fall in temperature, the metabolism will decrease 10 per cent. Once convinced that this physical-chemical principle held true for hyperthyroidism, we literally packed these cases in ice and have found that this procedure acts almost specifically in controlling the destroying metabolism. The patient is covered with a rubber blanket, surrounded and covered with broken ice, and an electric fan is used to promote evaporation. In one case the postoperative temperature was 106°, the pulse rose to 200; the patient was delirious

Fig. 1. Exophthalmic goiter. Reduction in mortality rate. Consecutive ligations.

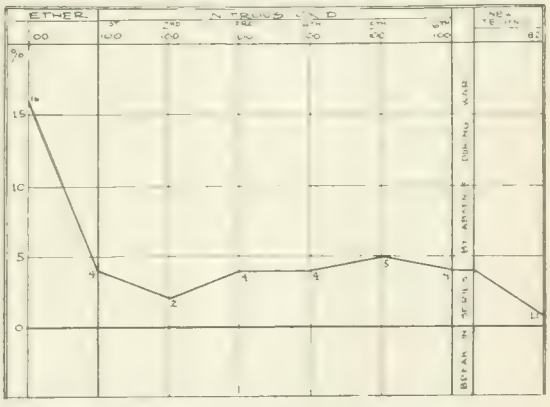

Fig. 2. Exophthalmic goiter. Mortality rate in consecutive thyroidectomies, June 28, 1906, to October 1, 1919.

[1] Presented before the Clinical Congress of American College of Surgeons, New York City, October 21, 1919.

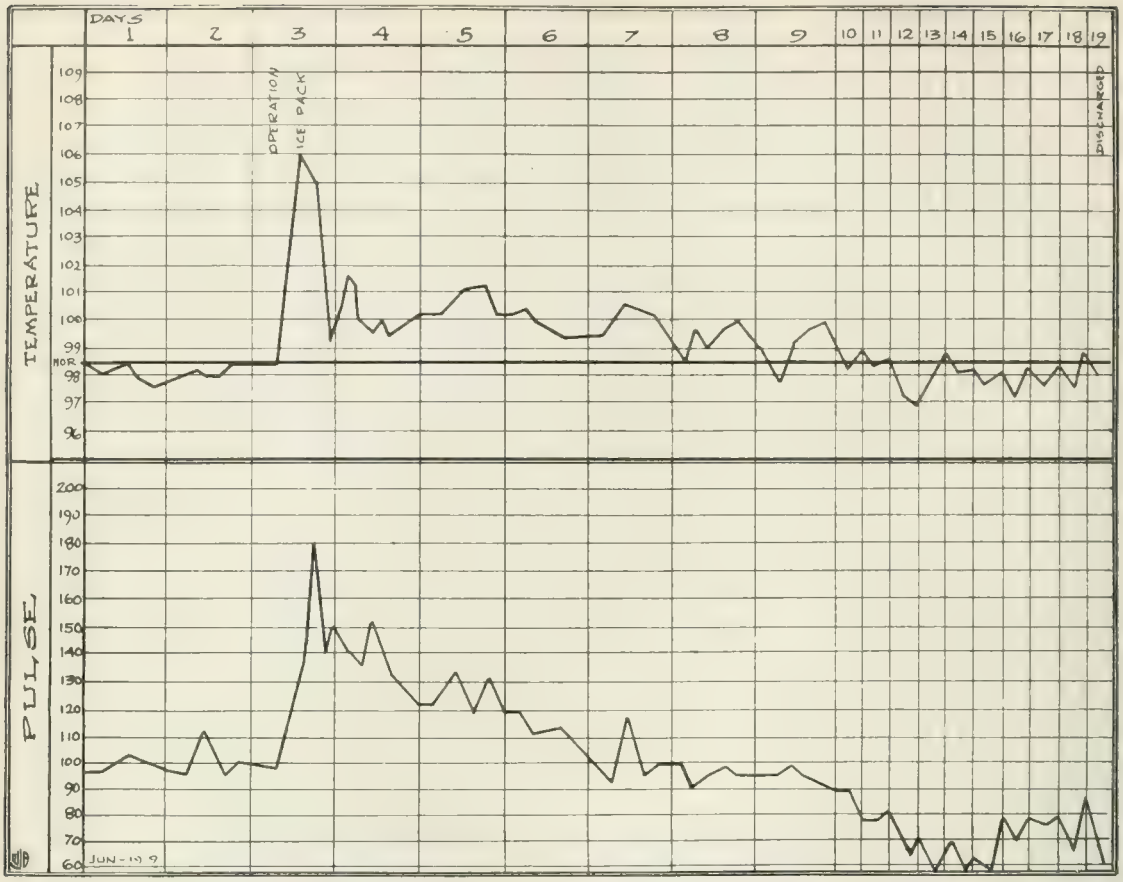

Fig. 3. Control of postoperative hyperthyroidism by ice packs.

and dying. He was packed in ice, and in two hours the temperature was reduced to 99.2°, the pulse to 140, and the patient was conscious and on the road to recovery (Fig. 3).

In grave risks the principle of the graded operation has been further extended by leaving the wound open and dressing it with 1:5000 flavine, a British war product, which holds the wound *in statu quo* for one, two or three days, as required, when further operation on the thyroid or closure of the wound is done in the patient's room.

Ligation is always done in the patient's room under nitrous oxid analgesia and local anæsthesia. In certain serious cases the lobectomy is done in the patient's room.

It is obvious that the state of the patient supplies the lead throughout; and that complete team-play among the professional, the anæsthetic, and the nursing staff is required. Indeed, these operations are not performed by the surgeon but by the hospital.

The following are the principal factors in our system of management:

1. The differential diagnosis is greatly aided by the Goetsch test and metabolism determinations.

2. The operative procedures are graded according to the severity of the disease.

3. The inhalation anæsthetic is nitrous oxid-oxygen, which is administered with the patient in bed; the operation being performed either with the patient in bed or after his transportation, under anæsthesia, to the operating room.

4. In moderate cases the entire operation may be completed at one seance.

5. In more severe cases the thyroid ac-

tivity is diminished by a preliminary ligation with the patient in bed, under nitrous oxid-oxygen analgesia and local anæsthesia.

6. In extremely grave cases it may be necessary to diminish the thyroid activity by multiple steps—ligation of one vessel; ligation of the second vessel; partial lobectomy; complete lobectomy—allowing intervals of a month or more between these stages, the length of each interval being determined by the degree of physiologic adjustment.

7. If during the operation the pulse runs up beyond the safety point, the operation is halted, the wound dressed with flavine, and the operation completed after a day or two when conditions have again become safe. In some cases, even though the thyroid has been resected, it is advisable to dress the unsutured wound with flavine and make a delayed suture in bed the following day under analgesia.

8. In certain cases lobectomy is performed while the patient is in bed and under nitrous oxid analgesia and local anæsthesia.

9. Psychic control of the patient on the part of the surgeon, the interne, the anæsthetist, and the nurse is required throughout to diminish the intense drive. An anociated regimen should be prescribed for the pre-operative, interoperative, and postoperative periods. The pre-operative and the post-operative management are of almost equal importance to that of the operation itself.

10. If, after the operation, the temperature becomes excessively high, with greatly increased pulse and respiration, the patient is packed promptly in ice.

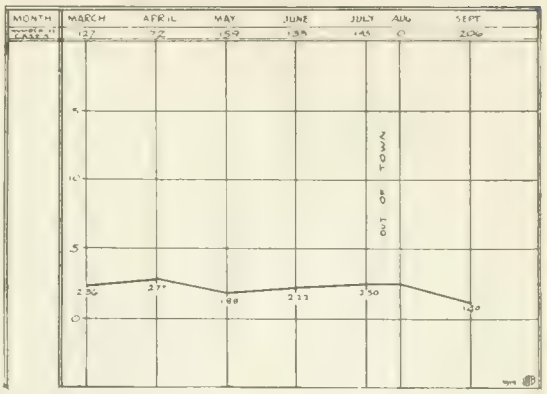

Fig. 4. Mortality rate. Total consecutive operations of all kinds, March 1 to October 16, 1919.

11. To avoid the effects of too sudden a withdrawal of thyroid secretion, thyroid extract is given the night before a lobectomy.

In this paper we have considered only the immediate surgical management of exophthalmic goiter. It should be noted, however, that the postoperative management of these cases is of equal importance.

Because of the striking benefits which follow the operation, and in view of the fact that a comprehensive surgical control yields a mortality rate of 1.1 per cent and excludes the rejection of any case on account of its gravity, we feel that the status of the surgical treatment of exophthalmic goiter is approaching the status of the surgical treatment of acute appendicitis.

THE ACUTE ABDOMEN [1]

By JOHN B. DEAVER, M.D., F.A.C.S., Philadelphia

THAT the acute abdomen is a condition calling for careful judgment and thoughtful consideration is obvious; that it occupies too prominent a place in mortality statistics is unfortunately all too true. And to our chagrin it must be admitted that among the reasons for this is the fact that too many untimely and unsuitable operations are performed in the treatment of this serious condition.

If I am right about the unnecessarily high mortality in acute abdominal conditions, may I not ask why this is so? It is in part due to the want of an intimate knowledge of living surgical pathology, in part to too great reliance on laboratory findings which do not always correspond to the findings at the autopsy *in vivo*, and furthermore to a hesitancy to resort to radical measures in the hope the symptoms may pass away under what is called conservative treatment. So they may and most often do with the passing away of the patient. Radical treatment in such instances would have been truly conservative because it generally conserves life.

The acute abdomen is not, as a rule, the result of virgin pathology. In the majority of instances it is only the outcome of a chronic pathological process which has given evidence of its presence for a well-marked period of time. How often in such cases the history reveals the presence of an antecedent lesion, such as a chronic gastric or duodenal ulcer, chronic disease of the gall-bladder or appendix, chronic pancreatitis, chronic pancreatic lymphangitis, torsion of the pedicle of a floating spleen, perforating ulcer of the large bowel; or in the acute lower abdomen chronic appendicitis, typhoid perforation, chronic salpingitis, ovarian cyst becoming twisted on its pedicle, chronic intestinal obstruction, as for example, circular carcinomatous compression of the sigmoid flexure, pelvic lesions or hernia of long standing, possibly incarcerated, or failing such definite conditions, there have been symptoms which to everyone acquainted with surgical disease of the abdomen should have pointed the way to surgical treatment.

Occasionally the acute abdomen results from conditions not easily recognized by even the most astute. Among such may be mentioned mesenteric thrombosis, acute obstruction due to internal strangulation by an unusual formation, such as a diverticulum, obstruction in an internal fossa, or a congenital hole in the mesentery or in the diaphragm. The following case illustrates an instance of obstruction through a congenital hole in the mesentery.

While cranking a Ford automobile Mr. — was suddenly seized with acute abdominal pain, necessitating his being placed in bed where he remained for several days, during which time he was under the care of the family physician. The pain subsided and recovery was prompt. Six months later, when again cranking his automobile, he suffered the same set of symptoms, which this time, however, did not disappear. This man was brought to the hospital under my care in a dying condition. No operation was performed. At postmortem was found a strangulated gangrenous coil of intestine through a congenital hole in the mesentery.

Infarct of the spleen causing acute abdomen I have seen upon more than one occasion. As to the reduction of a strangulated hernia *en masse*, I have operated upon a number of such cases. This condition is the result of injudicious prolonged taxis. Should not reduction by taxis of an irreducible hernia be delegated to the practice of the mediæval ages?

The more common of the causes I have mentioned should be recognized if our patients are carefully studied and examined and our faith has not been perverted, i. e., if we do not entertain the foolish belief that chronic ulcer, chronic gall-bladder disease, chronic pancreatitis, etc., can be cured by medicine, diet, visiting one of the famous springs, taking a rest cure, etc. This is a perverted faith, one that courts disaster, and places the subject of this pathology in constant danger.

[1] Read before the Clinical Congress of American College of Surgeons, New York City, October 23, 1919.

Again, not infrequently we have an acute abdominal condition following upon operation for relief of an acute or chronic surgical lesion. Such acute complications are intestinal obstruction, secondary abscess and peritonitis. The difficulty at times of being certain of the diagnosis and furthermore the fact that secondary or residual abscess formation may present two groups of symptoms or signs—those of abscess and those of intestinal obstruction—is appreciated by all who treat many acute intra-abdominal infections.

Still another division of the subject, the traumatic acute abdomen, affords many examples of difficult diagnosis. When a penetrating wound exists the indication is clear. Every abdominal wall which shows a penetrating wound, whatever its location and whatever the agent, should be opened. It is true that a small percentage of cases in some miraculous way will escape perforation of any part of the intestinal tract or damage to any essential viscus. But the majority show perforation of viscera, lacerations, hæmorrhage which urgently need direct treatment, although clinically there may be no evidence of serious injury. I have experienced cases where operation revealed complete section of the small bowel although the patient who had been run over across the abdomen by a heavy vehicle, showed no alarming symptoms nor any external evidence of injury.

Similarly severe blows on the abdomen, or a fall on the abdomen or the loins, or crushing accidents by wheels or between cars, etc., should bring to mind one of the various subcutaneous injuries that not infrequently occurs. In these cases it is better to open the abdomen on suspicion and find nothing, than to wait for an assured diagnosis of hæmorrhage or perforation. The man who is not more concerned about his patient's life than about a correct pre-operative diagnosis has a wrong point of view, to say the least.

Perforations of the gastro-intestinal tube are usually easy to diagnose because of the intense and sudden pain and the early board-like rigidity to which they give rise.

But in such insidious varieties of perforation as those occurring in typhoid, particularly the ambulatory type, or the perforation of an unsuspected ulcer of the colon, an exact anatomical diagnosis often cannot be made in time to save the patient's life. The important point is to recognize the presence of an acute abdominal catastrophe, and let the exact diagnosis follow upon the revelations of the aseptic scalpel.

The earlier the acute abdomen is seen the more confident can one be of the diagnosis, and the earlier suitable treatment is instituted the more favorable will be the prognosis. Of course by suitable treatment I mean surgery.

There are, to be sure, certain acute conditions of the abdomen in which surgery is not indicated and it is these that I place among the "untimely" operations which swell our mortality lists. Prominent among them are acute dilatation of the stomach, which to my way of thinking is not surgical. Whenever I hear of operation for acute postoperative gastric dilatation I cannot help feeling that the surgeon is ignorant of the rudiments of postoperative treatment of abdominal cases. Acute gastro-enteritis may simulate appendicitis and too often is operated upon with fatal results. A more frequent error, however, is made in regarding an acute appendicitis with peritoneal irritation as enteritis, and deferring operation until too late. The differentiation requires experience and diagnostic acumen but it can and should be made before resorting to operation. Pneumonia and diaphragmatic pleurisy causing upper abdominal rigidity and referred abdominal pains should be kept in mind since operation, especially anæsthesia, is particularly unfavorable to such cases. The gastric crises of tabes have also been a source of many mistakes in diagnosing the acute abdomen.

However, after considering all contra-indications to surgery and all conditions which simulate acute surgical conditions of the abdomen the greatest toll in lives is exacted as a result of delay in diagnosis and in instituting proper treatment. The reduction of the period between onset and operation is the prime factor. It cannot be too often repeated that during this period the essential point is diagnosis and not treatment. If treatment there must be at this time, and we

are not blind to the fact that the physician feels the strong pressure of the patient and the family to be doing something, the physician should be sufficiently cognizant of the real issue and sufficiently resourceful not to be deluded or forced into doing that which will endanger the certainty of the diagnosis or unfavorably influence the course of the disease (i. e., giving a purgative). I hail the opportunity of censuring this cursed practice. The doctor and the laity also know the harmful possibilities of the purgative. Would that my voice were strong enough to penetrate to every home in the world, and if heard there, my advice were heeded, in order that this malicious practice might be delegated to the oblivion it deserves. Mothers and all who use the family medicine chest must be made to realize the danger of using a purge in an acute abdominal crisis. In these conditions it should never be used except upon prescription by a doctor who himself is informed as to its dangers. "Evil is wrought by want of thought as well as want of heart." Here is a great field for propaganda and we are not doing our full duty unless we throw our weight into an educational campaign against indiscriminate purgation.

The danger of giving morphia before arriving at a diagnosis is, I believe, well understood and it is only the densely ignorant and the incorrigible who persist in this misuse of narcotics. The purge belongs in the same category since it is even more deadly than the opiate.

Are all those who insist upon purgation for the relief of an abdominal crisis, unaware of the advantages of the stomach tube as a means of forestalling a diffuse peritonitis in the lower abdomen? It would seem so, indeed. But judgment is required in the use of this instrument, for in the presence of perforation it is, of course, very dangerous.

Once the case is adjudged surgical and passed over to the surgeon, he finds himself saddled with a heavy responsibility; namely, when to operate. In obstructive conditions there is never anything to be gained by delay; the same is true in the presence of a continuing hæmorrhage into the abdominal cavity, as well as of the early stages of perforations into the peritoneal cavity. The nicest discrimination is demanded when dealing with inflammatory conditions involving the peritoneum. Diagnosis is essential in order to indicate treatment along lines best calculated to bring about recovery.

But in the type of acute abdomen that is amenable to surgery, early intervention, I need hardly tell you, is the best possible procedure. In this way only can we hope to prevent peritonitis, for finally whatever the origin of the acute abdomen, it is the peritonitis that kills. After peritonitis has once developed, especially if allowed to become diffuse, the more obscure will be the diagnosis and the greater the risk to life.

What more successful way is there of encouraging diffusion of a peritonitis than the giving of aperients or purgatives, in fact, internal medicine of any kind? I am sure that many of you have had the same experience that I have in being called in to cases that have been so successfully (?) purged and have subsequently developed a beautiful case of diffuse peritonitis, and then you are asked to undo the mischief by performing a miracle. It is flattering to the surgical profession to be credited with such miraculous powers, but there are few, if any, who can "call the bluff" in the presence of a diffuse peritonitis.

In practically all instances the type of peritonitis seen is due to the colon bacillus. While the colon bacillus is not necessarily the first micro-organism on the scene it is the organism very frequently met with in the majority of cases. In very early cases, the result of gastric or duodenal perforation, the fluid poured out into the peritoneal cavity is sterile; therefore, the results in very early operation are so successful. To illustrate this point I may recall my own statistics of 52 operations for this type of acute perforation, with one death. The fatality occurred in a patient sick several days, in whom was found in addition to the perforated duodenal ulcer a belly full of pus. In early acute perforations, cultures of the opening in the stomach and jejunum in the making of a gastro-enterostomy rarely if ever are other than sterile.

The variety of the peritonitis depends entirely upon the viciousness of the organism, the length of time that has elapsed since the

onset of the disease, and the resistance of the patient.

In the very early cases of the acute abdomen due to perforated duodenal or gastric ulcer, peritonitis is usually not at all pronounced—in the later cases it is circumscribed and diffuse. In the acute upper abdomen caused by acute cholecystitis, perforation of the gall bladder. acute pancreatitis, etc., the peritoneal inflammation appears early, and is at first circumscribed, but usually by the time the surgeon sees the patient it has become diffused. This is equally true of the acute lower abdomen, as for example, in ruptured extra-uterine pregnancy, where peritonitis, if it appears at all, does not set in until late in the stage. On general principles it may be said that in the acute abdomen with diffuse peritonitis, in the absence of a reliable history, or a reasonably sure diagnosis, and of a localized point, it is the part of good judgment to defer operation; treating the patient by strict anatomic and physiologic rest, or, as it is called at the Lankenau Hospital, regulation.

In the circumscribing. the circumscribed or the localized peritonitis with definite knowledge of the point of origin of the peritoneal inflammation, operation is comparatively, if not entirely, safe, depending wholly upon the proper technique, of course. Those who do not freely use gauze pads and gauze sponges (liberal size) in the protection of the surrounding peritoneum will expose the patient's life to greater risk than if the condition had been left to nature alone, and will probably have an uncalled for mortality. While I appreciate that all of my colleagues do not agree with me in this statement, nevertheless I am satisfied that I am correct in my stand.

The three dependable conditions necessary for the determination for or against operation are: first, experience; second, the interpretation of a carefully elicited history, although not feasible in all instances on account of the inability of the patient to express himself owing to great suffering or poor mentality; third, careful examination.

The value of experience can be disposed of in a few words, knowledge gained by observation at the bedside and at the operating table. Interpretation of a carefully elicited history is the pivot around which the diagnosis will be developed. Personally I attach more importance to a carefully taken history followed by careful study of the same than to anything else. I am sure I do not stand alone in this respect. In my affiliations with my house staff I have always laid great stress on this as one of the most important points in their training; a laborious part of their duties, I admit, but if properly and conscientiously carried out must necessarily be fruitful of results. It goes without saying that the examination of the patient must be given equally careful attention. The various laboratory methods of examination to which we have recourse and which are so useful in chronic illnesses, are, with few exceptions, not applicable to acute abdominal conditions. But if properly correlated and interpreted there are some which, in a small percentage of cases, are of value. Particularly is this true of the complete blood count. In passing I may say, that I never accept anything but the complete count, the leucocyte count alone does not satisfy me. At the same time, I may also say that I do not attach the same importance to the blood count as many others do, because I have so frequently had occasion to question its value. For example it does not always show the presence of pus. On the other hand, a high white count, as we all know, does not necessarily indicate pus. I have on numerous occasions been prevailed upon to operate or to support an opinion in favor of operation merely on account of a comparatively high leucocytosis. which to the attending physician indicated pus but which to my mind did not, and at operation my opinion was supported. How often have I known the hæmatologist to be the constant companion for several hours of the patient supposed to be suffering from a perforated ulcer, waiting for a rise in leucocytosis before agreeing to operation; a pitiful commentary upon the doctor's judgment in a case where early operation is so essential. The blood count is valuable, not as a substitute for clinical experience, but as an aid to it. That which I regard and have always taught as more reliable than a high

leucocyte count in determining the presence of pus is exquisite tenderness to touch. It is this sense of touch that many doctors, including surgeons, fail to acquire in spite of life-long practice.

In the decision whether and when to operate we must remember certain facts in the natural course of abdominal inflammations, namely:

All perforative inflammations tend to generalize.

Appendicular inflammations have a strong natural tendency to localize and so do cholecystic and pelvic inflammations.

Generalization in these cases is usually the result of improper treatment.

The principles which favor localization are now well known. Cases in the act of generalization may usually be induced to localize by proper treatment. The ideal treatment for all lesions which act by setting up peritonitis is to operate before the infection has established an independent footing in the peritoneal cavity. After the early and most favorable moment has passed the best time for operation will depend on the peritoneal process in the individual case. As already stated perforative accidents permit of small hope of localization, if any. Therefore, immediate operation yields the highest percentage of recoveries. Cholecystic and pelvic inflammations usually localize, and rather than operate in the presence of an acute, diffusing peritonitis with risk of spreading the infection to areas of peritoneum yet uninvolved, it is preferable to await further localization, and increase of the patient's resistance to the infection. In appendicular peritonitis the clinical evidence of the extent and severity of the peritoneal infection must be the guide. In localized peritonitis, whether free or confined, operation may be undertaken at once. In widespread involvement of the peritoneum with a severe infection, as manifested by marked tenderness and rigidity of the greater part of the abdominal wall and evidence of marked systemic absorption, it is safer to adopt the plan known as the Fowler-Ochsner-Murphy treatment and await localization. In spite of much that has been written and said upon the subject I am sure this is not generally accepted and applied and many lives are thereby lost. If ever there was a true word spoken it was that of the late Maurice Richardson, who said of these cases that they were "too late for an early operation and too early for a late operation."

Early operation refers to the stage of the disease and not to the time the patient is seen by the surgeon. I grant that it oftentimes takes courage for the surgeon to stay his hand. The physician, the family, and perhaps the other surgeons of the hospital or the community press for immediate operation. If the surgeon operates and the patient dies it is attributed to the disease. If he delays and the patient recovers it is not certain that recovery would not have ensued with earlier operation. But if unluckily the patient dies, as a small percentage will, the surgeon may find his delay blamed for the outcome. We should as a body stand behind the man who in these cases intelligently and conscientiously withholds his hand and waits for the favorable moment. Although in the minority, this type of cases furnishes a large part of the mortality of acute appendicitis and therefore is of relatively great importance.

Were there time I would like to elaborate certain other of my beliefs in the treatment of the acute abdomen, such as immediate operation and efficient drainage in acute pancreatitis, the efficacy of gastro-enterostomy as a primary operation in the treatment of perforated gastric or duodenal ulcers, the greater rationality and safety of the extraperitoneal incision in appendicular abscess, the folly of insisting upon always removing the appendix at the primary operation in such cases, the necessity for the use of gauze within the abdomen for the safe operative handling of infective conditions. These and many other questions I mention merely to call attention to the fact that even in this seemingly hackneyed subject, much that is important and life-saving has not as yet been thoroughly standardized.

Here is a field for research, quite as important, quite as dignified, quite as profitable as much that I observe as less worthily bearing the name of research.

EMPYEMA

With Particular Reference to Its Pathogenesis and Treatment[1]

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A KNOWLEDGE of the pathology and pathogenesis of empyema is of fundamental importance in order to understand the principles underlying its treatment. An extensive operative and autopsy experience as a member of the Empyema Commission has helped me considerably to clarify my notions of the pathology of empyema, and has profoundly modified my views concerning the treatment. I shall not enter at great length into the hitherto accepted views concerning the pathogenesis of empyema, except to say that the common understanding hitherto has been that the pleura becomes infected by contiguity from the inflamed lung. This view has not appealed to me for two reasons. My first objection is that this mode of infection does not occur in any of the other closed serous cavities of the body Take the peritoneum, for instance, and its most frequent source of infection, the appendix. Every surgeon with any experience knows that a diffuse peritonitis rarely if ever occurs unless there has been a perforation of the appendix, or its walls are so necrosed as to permit the easy transmission of bacteria into the peritoneal cavity. This is likewise true of the other hollow viscera of the abdomen. Reasoning by analogy, therefore, it is difficult to understand why the pathogenesis of infection of one serous membrane should be different from that of another. My second objection is that infection of the pleura by contiguity would presuppose a direction of the lymph current opposed to that demonstrated and accepted by physiologists and anatomists. To obviate this, a double set of lymphatics has been assumed, one passing from the hilum to the pleura, the other, passing in the reverse direction. This contention, however, is only a hypothesis and not a fact.

It has seemed to me, therefore, that upon theoretical grounds alone a different pathogenesis than that of contiguity is necessary to explain purulent infections of the pleura, and it has appeared to me to be very probable that gross contaminations of the pleura are the result of a focus in the lung, just as is true of similar infections of the peritoneum. On the constant lookout for such findings I was not at all surprised many years ago to find at autopsy an empyema that had resulted from a rupture of a small subpleural pulmonary abscess. I wondered whether this was not the common rather than the exceptional cause. As operation did not permit of sufficient exposure to demonstrate such a pathogenesis, it was necessary to seek a confirmation of our belief in autopsy material. Such material became available *en masse* at Camp Lee, in the spring of 1918, and in a series of perhaps three dozen autopsies, we were able to demonstrate in a great many instances one or more subpleural abscesses, some of which had perforated into the pleura. Additional corroboration of this pathogenesis was furnished by the influenza epidemic at Camp McClellan during my incumbency as chief of the surgical service. Lieutenant Colonel E. K. Dunham, who was associated with me on the empyema commission, again demonstrated a perforated subpleural abscess in every case of empyema that came to autopsy.

The localization of the empyema depends entirely upon the situation of the ruptured subpleural abscess. If, as usual, the empyema is a general or diffuse one, the abscess is usually located upon the convex surface of the lung. If the abscess is located in a fissure, an interlobar empyema results. When the abscess is on the mesial aspect of the lung, there are retrosternal pus pockets between the lung and the mediastinal pleura. The latter were more common in the earlier streptococcic epidemic than in the later influenza epidemic period.

As additional and perhaps obvious proof that ruptured subpleural pulmonary abscesses

[1] Presented before the Clinical Congress of American College of Surgeons, New York City, October 21, 1919.

occur in empyema is the frequent experience that irrigation of empyema cavities with irritating solutions, such as Dakin's solution, results in coughing and choking, showing that communications exist with a bronchus. This perhaps explains why in former years irrigations of empyema cavities with even bland solutions were considered impracticable. Such communications are furthermore often demonstrable by bismuth X-ray examinations I believe these communications exist in every empyema; if small, they heal promptly; if large, they may be the cause of considerable difficulty during the treatment.

I need hardly dilate upon the fact that smaller and larger abscesses occur not only beneath the pleura, but well within the parenchyma of the lung in pneumonias, especially in those of the streptococcic variety. If small, they may be absorbed; others rupture into a bronchus; if the infection be comes attenuated, they become remediable by operation; usually, particularly if they are multiple, they cause a fatal sepsis. The subpleural varieties offer perhaps the most favorable prognosis, because at worst, they form an empyema by rupturing into the pleural cavity. When they do, the rapid development of empyema is, I believe, hastened by the presence of the small amount of serous fluid in the pleural cavity, which is present in every case of diffuse pneumonia.

The analogy between infections of the pleura and of the peritoneum is therefore remarkably complete. Unruptured infections within the abdomen also cause serous exudates, which, if uninfected, become absorbed. The one important physiological difference between infections of the pleura and peritoneum is the greater and constant mobility of the lung, as compared to the sluggish peristalsis of the intestine, so that adhesions are less liable to form; a free serous pleurisy is, therefore, the rule.

When now the serous pleurisy is converted into a seropurulent or purulent exudate, encapsulation occurs just as in the peritoneum, and is due to a deposit of fibrin on the periphery. The encapsulation also, as in the peritoneum, may be diffuse, localized, or multiple. Owing to the recumbent posture, the fluid usually collects in the supradiaphragmatic and posterior portions of the thorax, giving rise to the most common form of empyema. Isolated and localized forms, however, are frequent findings, and multiple encapsulations are not uncommon.

The important point to remember, especially in reference to treatment, is that whereas a serous or seropurulent pleurisy is always free, a purulent pleurisy is nearly always encapsulated. The encapsulation may enclose an extensive area, almost the entire pleural cavity, but at some line or another, adhesions between the parietal and visceral pleura are nearly always found. An absolutely free empyema occupying the entire pleural cavity, is, in adults at all events, rarely found.

TREATMENT

Primarily I wish to emphasize that empyema, in the stage in which frank pus is obtained by aspiration, is already an end product, the terminal event of an infectious process, in which the first stage is a pneumonia with a small serous pleurisy, and the second stage, a pneumonia with a greater exudation of seropurulent material. The treatment of empyema really begins in the latter stage, so that in this disease as well as in all acute surgical infections, an early diagnosis is of prime importance. Speaking again in terms of analogy, it would be equally as logical to begin the treatment of appendicitis only when an abscess is formed, as to initiate the treatment of empyema only when the exudate has become manifestly purulent. It was not merely the observation of empyemata *en masse*, but the opportunity to witness the development of an empyema from its very incipiency, that made my military experience in this disease of so much value to me.

I have therefore divided the subject of the treatment of empyema into three stages: (1) the formative stage, (2) the acute stage, and (3) the chronic stage.

1. TREATMENT OF THE FORMATIVE STAGE

The formative stage of an empyema begins with the rupture of the subpleural abscess. There ensues promptly a rapid increase of fluid, and the conversion of the serous into a

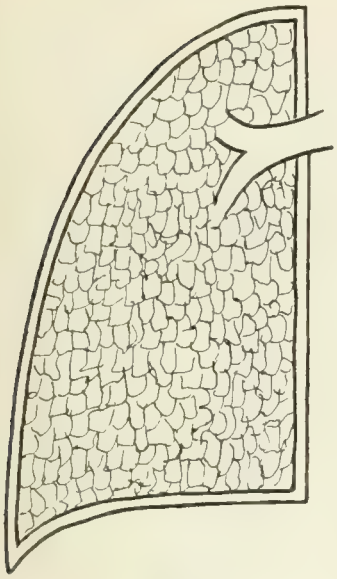

Fig. 1

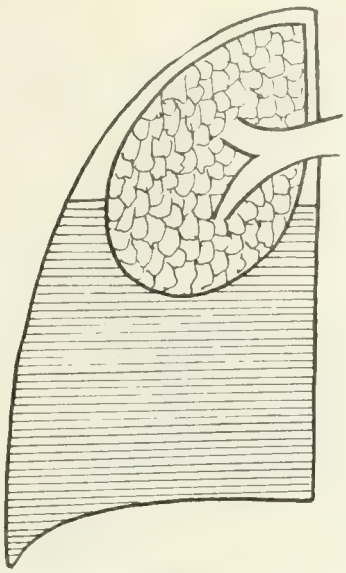

Fig. 2

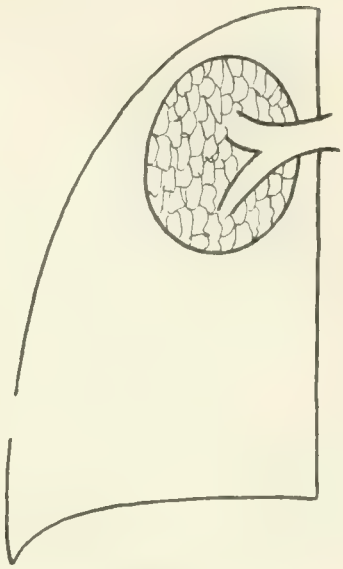

Fig. 3

Fig. 1. Diagram representing one half of the normal thorax.

Fig. 2. Fluid collected in the dependent portion of the pleura crowds the lung upward and toward the vertebral gutter.

Fig. 3. Pneumothorax following a large thoracotomy.

seropurulent exudate. It appears to me that the rapidity of the formation of this exudate, as well as its amount, depends somewhat upon the nature of the infecting organism. In the epidemic caused by the streptococcus hæmolyticus, the fluid developed and reaccumulated much more rapidly than in the later influenza epidemic.

During the formative stage the patient is suffering from a number of things, for each of which treatment is indicated.

1. The toxæmia. This brings in its train a tremendous loss of nitrogen. This observation and its therapeutic importance has been made the subject of an exhaustive study by Captain Richard Bell (1), of the empyema commission. To replace this loss, the patient must be fed on a diet rich in calories. Clinical observations have corroborated the great value of this measure.

2. The pneumonia. I shall not enter into the treatment of this complication, because it is entirely a matter for the internists.

3. The presence of fluid in the pleura. I purposely avoid the word exudate, because I am now referring entirely to the mechanical effects of the fluid itself. These mechanical effects may be deleterious for three reasons: first, from compression of the affected lung; second, by pressure upon the mediastinum, and compression of the uneffected lung; and third, and most of all, by pressure upon the heart, and consequent kinking of the great vessels. It is for this reason that left-sided exudates are borne less well than those on the right.

To relieve these mechanical effects of large exudates, we resorted to the simple device of aspiration with an apparatus that does not permit the entrance of air.

It was truly remarkable to witness the almost immediate benefits of this measure. The patients were more comfortable, the dyspnœa was less, the cyanosis was not so marked, and the pulse improved in quality. Aspiration was repeated as often as the fluid reaccumulated in amounts sufficient to demand it; in some instances, especially in the streptococcic form as often as every twelve hours. In a few instances aspirations were even curative.

The question may now be asked, Why

was not an early thoracotomy done? On theoretical grounds, such an operation might obviate both the mechanical and toxic effects of the exudate. Practically, however, an early thoracotomy is absolutely contra-indicated, and for the following reasons: I shall elucidate my argument by first describing the pathogenesis of pleural exudates.

A vertical section of one-half of the normal thorax may be represented as in the diagram, Figure 1. As is seen the lung entirely fills the pleural cavity; the parietal and visceral pleura are in contact, being separated merely by a very thin layer of fluid.

If an exudate or transudate forms, the fluid, being heavier than the air containing lung, collects in the dependent portions of the pleura, and crowds the lung upward and toward the vertebral gutter. This is represented diagrammatically in Figure 2. This is what usually happens in pleurisy with effusion, in pleural transudates from cardiac or kidney disease, etc.

Suppose now that a subpleural pulmonary abscess ruptures, and an early empyema develops. There is a sudden increase in the amount of exudate, and a corresponding aggravation of symptoms. If a thoracotomy is now performed, the fluid suddenly escapes, and there is an equally sudden inrush of air, followed by an immediate collapse of the lung. This is illustrated in Figure 3. The occurrence just related is immediately followed by a fluttering of the as yet uninfiltrated mediastinum, impairing still further the action of the heart. Finally, if the patient survives, the mediastinum becomes fixed with the convexity toward the unaffected side. This condition is represented diagrammatically in Figure 4. (In parenthesis I merely wish to mention, that these observations upon pneumothorax apply only to large thoracotomies, and not to instances in which the opening is of smaller size than the chink of the glottis.) The pathological physiology of pneumothorax has been ably investigated by Garre and Quincke (2), and by Graham and Bell (3) of the empyema commission.

Putting theory aside, however, early thoracotomies are attended by a terrible mortality, as the statistics in our military camps during the epidemic of 1917 and 1918 woefully testified. Early operations were probably prompted by the enthusiasm of both internists and surgeons, who for the first time saw empyemata in large numbers develop under their very eye, and felt that early operation, which in other suppurative surgical affections is a great desideratum, would give similarly brilliant results. It was only when frightened by the formidable mortality that a halt was called on early operations, and the statistics improved. The patients died not only in large numbers, but promptly after the operation. When we consider that these operations were done upon a patient who was at the same time sick unto death with an active pneumonia, it is not surprising that the mortality was so large.

Another but less important contra-indication to early operation is the fact, that even if the patient survives, the lung becomes fixed in its collapsed position by adhesions, so that a huge empyema cavity results which takes an interminable time to heal.

To sum up, the treatment of empyema in the formative stage resolves itself to the formula *nil nocere*. The only surgical procedure indicated is aspiration of the chest.

II. TREATMENT OF THE ACUTE STAGE

When the seropurulent fluid changes into pus, adhesions form between opposing surfaces of the pleura. A cross section of the chest in such a condition is represented in Figure 5. These adhesions are important, because they anchor the lung to the parieties. The thorax therefore can now be opened without causing collapse of the lung. A cross section of the thorax after opening is represented in Figure 6. I am speaking now only of the commonest form of empyema, namely those situated in the supradiaphragmatic and posterior portion of the chest. Slight variations obviously occur in empyemata in other situations, but the underlying principles remain the same.

I do not know just when these adhesions form; the important point is that I have practically always found them when the chest contains frank pus; so that, I repeat, nearly every empyema is an encapsulated one.

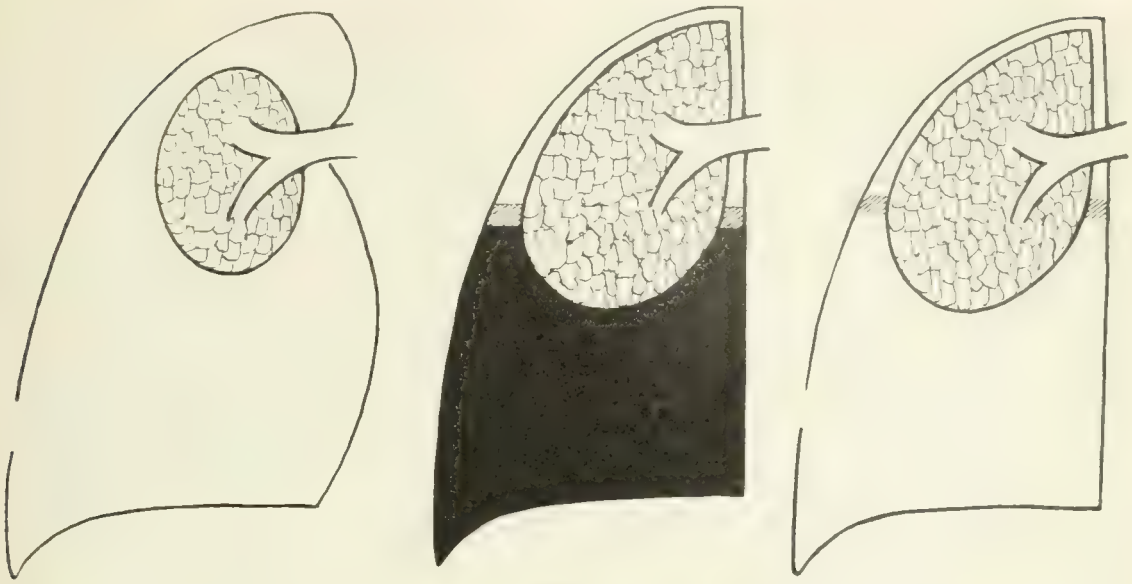

Fig. 4 Fig. 5 Fig. 6

Fig. 4. Cross section of the chest showing pneumothorax with mediastinum fixed with convexity toward the unaffected side.

Fig. 5. Cross section of the chest showing adhesions between opposing surfaces of the pleura due to the change of the seropurulent fluid into pus.

Fig. 6. Cross section of the chest showing opening in chest wall and evacuation of pus.

Furthermore, the patient at this time is in a much improved general condition; the pneumonia is over, and the general toxæmia has subsided. We have nothing to contend with now but the empyema, which causes symptoms from absorption of toxic material and from the mechanical effects of the fluid alone. The dangers from absorption, have, I believe, been hitherto greatly exaggerated, and while I do not advocate needless delay in performing a thoracotomy, the necessity for this operation is by no means urgent. Indeed, the only indication for urgent thoracotomy is in those exceptional cases, in which a pulmonary abscess, directly in communication with a large bronchus, ruptures into the pleura. There is thus formed an acute hydro- or pyopneumothorax under extreme tension, due to the continuous escape of air into the pleural cavity. The condition is diagrammatically represented in Figure 7. These patients suffer intensely from dyspnœa, and as the lung is already collapsed, no harm can be done by an early thoracotomy to afford relief.

The operation of thoracotomy for empyema is extremely safe. It consists simply in evacuating an encapsulated abscess lined by a thick pyogenic membrane. I shall not describe the details of the operation; I have described the procedure fully in a previous article (4).

The after-treatment is carried out upon the lines of the Carrel-Dakin method; the details of which have been fully described in the article previously mentioned. I again wish to emphasize that success depends upon its correct application. Those who deprecate its value in empyema, I am convinced, fail to use it correctly. There is nothing magical in its effects and it can never supplant good surgery, but I regard it as the most valuable adjuvant in the treatment of empyema.

III. TREATMENT OF CHRONIC EMPYEMA

In view of the experiences which I have gained, particularly during the past two years I have a certain diffidence in defining the word "chronic" as it bears upon a case of empyema. Formerly, a case of empyema which did not heal, or which lasted a long

time, and which usually required a second operation for healing was considered chronic. I do not consider this definition a very happy one, for reasons which will become apparent.

My conception regarding the manner in which an empyema heals has undergone a very radical change since my recent experience. Formerly I was under the impression that an empyema healed in only one way, namely by a process of obliteration of the pleural cavity, which in turn was caused by a gradual expansion of the lung, and the formation of adhesions between the visceral and parietal pleura. Only when the entire affected pleural surfaces became adherent did the drainage opening close. This is the only method of healing that was known up to 2 or 3 years ago, and may for that reason be called the "classical" method.

It has been stated that a properly drained empyema, even without the use of any antiseptics, sterilizes itself, but I have never found this to be the case; on the contrary have found numerous bacteria up to the very moment of final closure. When a cavity has persisted, I have observed, that the drainage opening does not show the slightest tendency to close; on the contrary in spite of earnest prayers and perhaps extensive operations, it has failed to close in many instances.

During the past three years the following variations in the method of healing of an empyema have been encountered:

1. The far-reaching observations at the War Demonstration Hospital of the Rockefeller Institute have taught us that empyema cavities can be rendered bacteriologically sterile by means of the Carrel-Dakin treatment, and when sterile, the drainage opening can be closed by secondary suture. According to the reports from the Rockfeller Institute, a definite cure results in about 75 per cent of the cases. Personally I believe that recurrence follows in a certain percentage of these "cured" cases; but there is no denying that a real cure follows in some cases. I am not aware that the method of healing has as yet been described by the originators of the method. My own observations in a few cases have led me to the conclusion that the cavity heals by the absorption of the sterile exudate that fills the cavity after closure of the wound.

2. During my stay at General Hospital No. 12, I had an experience which threw a flood of light upon my speculations as to the closure of empyemata. An empyema, treated by the Carrel-Dakin method had been finally allowed to heal. About one month after healing, Franklin A. Stevens, my colleague upon the empyema commission, found upon routine physical examination, which was subsequently verified by X-ray examination, that the patient had a definite pneumothorax. I watched this case with great interest and care. An occurrence of this nature was unknown to me, and I confidently looked forward to a reaccumulation of the pus. The unexpected, however, happened; not only did no reaccumulation occur, but the pneumothorax disappeared and was replaced by the expanding lung.

3. The occurrence in the case just related made me think very hard. It gave me the clue that I needed. Whereas up to that time operations upon cases of chronic empyema were of almost daily occurrence with me, I immediately ceased all further operating, and merely proceeded with the intensive sterilization of the cavity. When sterilization was complete, all treatment was discontinued, and the outer wound was allowed to close. Subsequent examination showed that the healing occurred through the intervention of a pneumothorax, as in the case just related. Having found this last method to be so successful, I have adopted it as the routine method in all empyemata.

There are, therefore, in addition to the "classical" method at least two other methods of healing an empyema. It is on this account that I now find difficulty in exactly defining the word "chronic" as it relates to empyema. In the light of our present knowledge, I would exclude from the chronic group any case of empyema which is amenable to sterilization by means of the Carrel-Dakin treatment.

If the cases of empyema, which cannot be remedied by even long-continued treatment with Dakin's solution are examined, there will always be found a definite underlying cause, the removal or eradication of which,

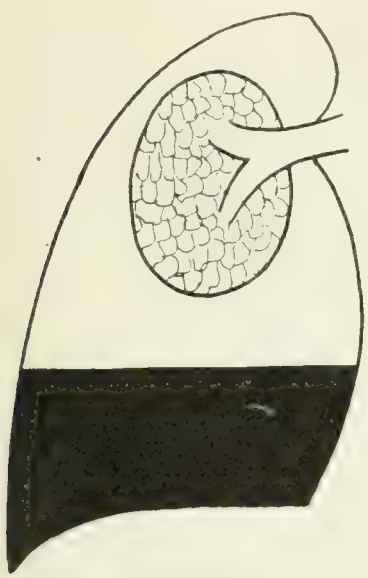

Fig. 7

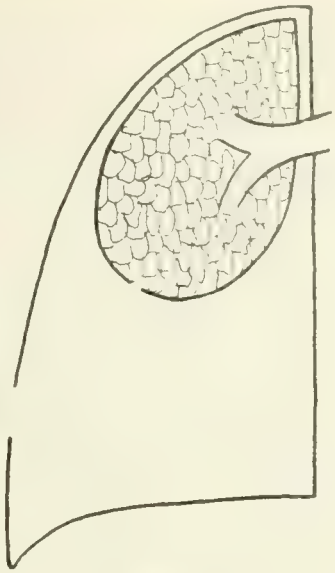

Fig. 8

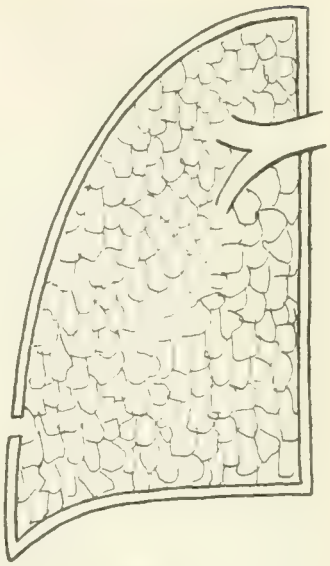

Fig. 9

Fig. 7. An acute hydropneumothorax or pyopneumothorax under extreme tension calling for immediate thoracotomy.

Fig. 8. Pleuropulmonary fistula.

Fig. 9. Bronchocutaneous fistula.

occasionally by a trivial operation, will lead to a successful issue. These reasons are few in number, viz.:

1. Cases in which the drainage opening is not favorably placed.
2. Cases with contracted drainage opening.
3. Cases with necrotic ribs.
4. Cases with retained foreign bodies.
5. Cases with side pockets and lateral branch sinuses.
6. Pulmonary fistulæ.

The indications for the treatment in the first four conditions mentioned above is self-evident. In the treatment of the cases with side pockets and lateral branch sinuses an accurate diagnosis of their location and extent is of prime importance. This can be readily done with the X-ray after injecting an opaque substance. Such side pockets should be opened (usually by costatectomy) and treated independently of the main cavity. When this is impossible their exposure through a large intercostal incision by way of the main cavity is indicated.

The treatment of pulmonary fistulæ is somewhat more complicated and on that account deserving of detailed discussion. The etiology of these fistulæ has already been discussed in detail in the chapter on pathogenesis. When the abscess causing the empyema is small, and the opening into the bronchus also small, the perforation usually closes early, so that the injection of Dakin's solution may be carried out without causing diagreeable by-effects.

If there is a communication of the abscess with a bronchus of larger size, we obtain a not infrequent complication known as "pleuropulmonary" fistula (Fig. 8). In the presence of this lesion distention of the cavity with large quantities of Dakin's solution causes a very distressing cough and choking sensation. However, they tolerate the instillation of smaller amounts with perfect comfort; more particularly if attention is paid to the posture of the patient while the fluid is instilled. A position will nearly always be found in which the instillations do not cause distress.

In rare instances the fistula is of unusual size, varying in diameter from that of a pencil to a little finger.

Finally it may happen in some cases of empyema, particularly those that have drained for a long time, that the lung has

expanded until it fills the entire pleural cavity. In such instances the opening into the lung may become adherent to the drainage opening. There is thus formed a short channel, leading directly from the skin into a bronchus. On coughing, air and a slight amount of bronchial secretion is expressed. A sinus of this description should be called a "bronchocutaneous fistula (Fig. 9). They are exceedingly difficult, if not impossible, to cure without operation, because the bronchial and cutaneous epithelium become continuous and form a so-called "lip fistula."

In rare instances I have succeeded in curing such a fistula by a thorough cauterization of the tract with a fine Paquelin cautery; more often this procedure is not successful. Formerly I practiced extensive operations upon these cases, the operation consisting in an extensive thoracoplasty followed by the excision and suture of the sinus. I believe, however, that in most instances this is not necessary. Satisfactory results are obtained by mobilizing the lung and excising the sinus, thereby converting the bronchocutaneous fistula into a pleuropulmonary fistula. The subsequent healing is not as a rule protracted. An inversion suture of the fistulous opening in the lung may shorten the period of healing.

RECURRENCES

The question of recurrences is intimately connected with that of chronic empyema; in fact chronic empyema may well be defined as one which has a tendency to recur.

If we analyze the physical forces which enter into the healing of an empyema, we will find that they are composed of a number of factors, all of which tend to diminish the thoracic cavity. They are, first, the diaphragm ascends; second, the direction of the ribs becomes more vertical; third, the intercostal spaces become narrower, and fourth, the arc of the ribs approaches closer to the median line. At the same time the lung expands until the parietal and visceral pleura become adherent. It is only when this stage has been reached that we can speak with any degree of certainty about a cure; whenever a space is left there is always the possibility of a recurrence. Broadly speaking, therefore, these reaccumulations are always a reflection upon the treatment, for they usually mean that drainage and antiseptic treatment of the cavity have been discontinued prematurely. I have found that this contingency is particularly liable to occur if the external incision is closed operatively, because it not infrequently happens that good judgment is supplanted by haste Even the strictest precautions such as smears and bacteriological cultures, do not always furnish a reliable guide to the presence or absence of micro-organisms. It again only proves the value of the well recognized axiom in medicine, that a negative proof is no proof. An excellent résumé of the recurrences after empyema has been compiled by Franklin A. Stevens (5). Stevens shows that recurrences are less frequent after the Carrel-Dakin treatment, as proved by the following figures: (1) Healed without Carrel-Dakin treatment, 56 cases, recurrences in 10 cases, or 18 per cent; (2) healed with Carrel-Dakin treatment, 63 cases, recurrences in 3 cases, or 4.7 per cent.

The diagnosis of recurrent empyemata is difficult if the signs and symptoms are not marked. Examinations with the X-ray, especially stereoscopically, are of prime help.

The treatment of recurrent empyema differs in no way from that of ordinary empyema. Owing to the narrowing of the intercostal spaces it is usually preferable to resect a rib.

CHRONIC EMPYEMA SINUS

It has been customary to make a very definite distinction between these and the previously discussed cases of chronic empyema. There is in reality no difference; it is merely a question of degree. Cases of chronic empyema exist, in which there is a large cavity and a short sinus; others have a long sinus and a small cavity. Special operative procedures in large numbers have been described, most of which, to my mind, without any particular justification. I believe what I have said of the treatment of chronic empyema in general, applies to that of the chronic sinuses as well.

MAJOR THORACOPLASTIC OPERATIONS

In spite of the best of care some cases of empyema will not heal. I have no hesitancy

in stating, however, that if the treatment of the acute and chronic stage is carried out along the lines laid down in previous portions of my paper, their number will be infinitesimal as compared to former times. It is in these cases, and in these cases only, that recourse must be had to one of the major operations, so called.

The major operations (and I use the word "major" deliberately, because not one of the originators of the method will own up to the real "major" character of his operation) can be divided into two main groups:

1. Those which aim to obliterate the empyema cavity by collapsing the chest wall (Estlander, Schede, Quénu, Beck).

2. Those which aim at a re-expansion of the lung by freeing it from the heavy fibrous deposit which binds the lung down (Delorme, Fowler, Ransohoff, Lilienthal).

It is exceedingly difficult to make a positive indication as to the choice between these operations. They all have a very definite mortality. The lowest mortality is in the Estlander operation (about 15 per cent), but the real indications for this operation are exceedingly limited. The Schede operation has a much higher primary mortality (about 25 per cent). The definite cures in all vary between 50 and 60 per cent.

During my military service, before I found that I could heal chronic empyema by simpler methods, I performed a number of Schede, Estlander and Delorme operations. All of my patients were in such excellent physical condition, through their preliminary treatment and sterilization, that I did not have a single fatal issue. In passing I may mention, that I have found the decortication operation particularly difficult in the empyemata caused by the hæmolytic streptococcus. Of late again, more frequent recourse is had to the decortication operation in the army, and I am given to understand with very gratifying results.

CONCLUSIONS

1. Empyema in most instances results from the rupture of a small subpleural pulmonary abscess.

2. An empyema is the final stage of a process, in which the first stage is a serous pleurisy, and the second a seropurulent pleurisy. The latter is the so-called "formative" stage of an empyema.

3. The "formative" stage of an empyema is unaccompanied by recent pleural adhesions. The stage of "acute" empyema is always accompanied by adhesions.

4. The vast majority of empyema is of the encapsulated variety. Very few occupy the entire pleural space.

5. The treatment of empyema should be begun in the formative stage before the exudate has been converted into frank pus.

6. It is unwise to perform an operation in the formative stage. The mortality is terrific, because the accompanying pneumonia is still in full bloom, and furthermore, because of the absence of adhesions there occurs an acute pneumothorax with "fluttering of the mediastinum," and consequent embarrassment of the action of the heart.

7. The best surgical procedure in the formative stage is repeated aspirations, done as often as is indicated, in order to relieve the embarrassment due to mechanical pressure of the rapidly accumulating fluid. In a few cases this measure is even curative.

8. Feeding with a diet rich in calories is an important adjuvant in the treatment of the formative stage.

9. The treatment in the acute stage of empyema consists in simple intercostal thoracotomy. This operation need not be considered an urgent one, and should be performed when the patient's condition is otherwise perfectly satisfactory. This is the so-called "late" operation.

10. Urgent thoracotomy is indicated only in acute pyo-pneumothorax.

11. The Carrel-Dakin treatment has proved of superlative value in the postoperative treatment of empyema, and should be instituted in every case. There are no contraindications to its use.

12. The mortality of acute empyema by these methods is lower than that reported by other methods of treatment.

13. Empyema cavities heal by three methods:
    a. By the formation and absorption of a sterile exudate.

b. By the formation and "absorption" of a closed pneumothorax.
c. By the "classical" method, i.e., expansion of the lung and obliteration of the pleural cavity.

14. Chronic empyema should not occur, or should at least become very rare, if the methods of treatment of acute empyema, as formulated above are practiced.

15. "Chronic" cases may, therefore, be defined as empyemata which are not amenable to treatment with Carrel-Dakin.

16. Recurrences in empyema are usually the result of undue haste in closing the thoracotomy opening. The percentage of recurrences is less after the Carrel-Dakin method of treatment than after any other.

17. The vast majority of operations that have been devised for chronic empyema will have a very limited field of usefulness, if the methods of treatment advocated above are carried out.

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THE PHYSICIAN AND SURGEON IN THE INDUSTRIAL ERA[1]

By OTTO P. GEIER, M.D., Cincinnati, Ohio

IN the great chaos of world thought today two outstanding problems present themselves for solution: (1) How may international peace be brought about? (2) How may industrial or national peace be brought about?

I hold that these two questions are inseparable. Permanent international peace will never exist until there be peace and unity among the people that go to make up each nation. The master minds of the world are at work on the first problem.

The second problem, touching upon industrial peace—the success, health, unity, and contentment of the people of the nation, is the one that concerns us tonight. It is individual—it is directly and universally personal. No one of us can escape the responsibility of finding answer to the question that bears on the success, health, and peace that shall come to each individual, the sum total of which is finally forged into a national life. How this may be brought about; how these individuals may be drawn nearer to an established order of peace and harmony; how they may be influenced toward maximum production for their own success and for the community welfare; how they may be brought to their best citizenship, actively in support of their own government; and finally, how that government may come to be but the composite expression of the best desires and ambitions of men, is the special challenge that comes to the medical profession.

It has been indelibly impressed on us these past few years that if the majority of the persons that make up a nation are badly dealt with; if they believe injustice prevails, if they feel that their living and working conditions are unfair, then a state of unrest and publicly expressed dissatisfaction will result, production is interfered with, suffering and want ensue, government then becomes unstable, and crime of every known variety becomes rampant. These things are destructive to citizenship—they are a blight on national life.

Our subject, "The Physician and Surgeon in the Industrial Era," is most timely. This is not only the industrial era, but also the era of greatest industrial strife. Public disorder and strife originate almost wholly in the clash of opinion between organized money and organized labor. Strikes and lock-outs, with their attendant turmoil, are but outward signs of a constant warfare that is going on between these groups. Thus we are uncomfortably reminded daily that ours is the in-

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dustrial era; that the individualistic viewpoint no longer holds; that we must adjust our work and our thinking to large groups and great units of society; that we must think in terms of the mass rather than of the individual; that this is the day of group action; that this is the day for mass treatment.

Recall, if you will, the national peril of business stagnation and starvation that England has just faced; recall also the similar situation in our own country three years ago when the railroad brotherhoods forced the nation to its knees in the passage of the Adamson law. Its recent arrogant progeny is the Plumb bill. We have but just passed the crisis of the steel strike, only to be threatened by a coal famine, with its almost limitless possibilities for nation-wide disaster. Here the ultimatum of organized labor is for a six-hour day, a five-day week, and 60 per cent increased pay. This is but another example of the vicious, ever-widening circle of higher costs with lowered production; yes, actual shortage of an industrial and domestic necessity.

This type of demand by labor, coupled with successful propaganda by the I. W. W.'s, the bolsheviki, and the radical socialists, strikes terror to all serious thinking men. Russia exemplifies what happens to industry and production when rampant radicalism overwhelms a country. Industrial stagnation —insufficient production—hunger, means a revolution. All men and groups of men of any moral or mental status or leadership must definitely assign themselves to the task of stilling the present unrest. Selfish interest and self welfare demand it. The wave of temporary patriotism is over. The patient understanding and daily patriotism must prevail for the future years. No class is more challenged by these facts than is the outstanding group of physicians and surgeons.

What part is our profession playing in this post-war psychology—this industrial and social crisis? Are we making our contribution to the study of the problems of industry and labor? Have we adjusted the science of medicine to the needs of these two groups, or have we practiced our profession with individuals just as we might have done one hundred years ago? Have we not failed to develop a consciousness of group problems?

Bear with me in asking these personal questions. Is it not paradoxical that the physician, who to his patient appears as the most socially-minded individual, should prove so unsocial and so inactive in his public thinking? Is it not strange that we who have the closest view of the intimate living and thinking of the people, should play so small a part in the disposition of their individual or group lives? Dare we any longer stand aloof and fail to make ourselves felt in the great social and economic changes that are taking place? Is it not equally strange that we should retain such a narrow perspective of the capacity of the profession to assist in these national problems? Health and sanity —these are basic of all these considerations. Are we doing all we can to bring them about? This would seem to be our especial function in society. And yet the most far-reaching social measures which have to do with care and cure of disease and accident have been, and are being framed into legislation without taking us into account.

As an illustration, were our surgeons carefully consulted when Workmen's Compensation Acts, for the care of industrial accidents, were established? Are we satisfied with the application of this law? Isn't it a fact that, generally speaking, medical men, not qualified surgeons, are tinkering with the industrially injured? For the worker, this means prolongation of the case, greater loss of wage, unnecessary invalidity, with practically no scientific rehabilitation; for the employer, it means the idle machine, lowered production, with higher cost; for society, it inevitably means definitely lowered standards of living and higher costs of living.

On the other hand, was the profession entitled to much consideration? Is it not a fact that for years we blindly went on repairing the hundreds of thousands annually injured and maimed, without public protest and without suggesting an improved program? It occurred to labor to seek compensation for lost time from accidents, and payment by the state of the surgeon's fees. In the very nature of the case, labor could have

no knowledge as to how to obtain the best surgical results for the injured, yet they dictated the law. Moreover, it remained for industry, not the profession, to set under way that wonderful safety first movement, which has reduced death and accidents by approximately 50 per cent. Is the obligation not upon us now to propose the proper type of surgical organization under Workmen's Compensation Acts that shall place all of the surgery rendered the injured workmen under the supervision of the best trained men in the profession, who, with a corps of assistants, and with the states divided into districts for such supervision, will see to it that justice is done both the injured worker and the profession?

Are we not assuming the same negative attitude toward the movement for the better organized application of group curative medicine? Are not the physicians practically being ignored by the framers of Compulsory Sickness Insurance, another group program? And yet we shall all admit that the future of the scientific teaching of medicine, as well as its economic practice or application, will be absolutely determined by the enactment of such a law. Unless the profession comes out of its social, or rather unsocial torpor, we may be sure that such legislation will be made to fit the whims of the perniciously active reformer, whether or no it pleases us or benefits labor or capital. Here again we have permitted industry, unaided, to visualize, ahead of us, the necessity of a constructive, preventive health program, as an integral part of any intelligent legislation for Health Insurance. Does this recital of our social inactivities possibly suggest why we have been so unsuccessful in our demands for a Federal Department of Health?

How can we understand and contribute to economic and social legislation unless we get a near view of the problems of labor and industry? Can we do this best merely by prolonging our scientific discussions in sequestered places, or by also entering into the life and understanding of industry, learning there to apply our science intensively for the early recognition of disease and its prompt cure? It is here through supervision of the group that education of the adult for the prevention of disease and accident may be best applied. Energy applied to the group always means a maximum result with a minimum effort. On the other hand, can we hope to mold the attitude of organized labor toward health programs unless we offer a solution to the back-breaking load that preventable disease and suffering is causing the worker? Are we strong enough to overcome its objection to physical examination and medical supervision of the worker as a national economic asset?

We must recognize that almost all old standards of thinking are in the discard. We are passing through a period of unstable thought. The pendulum has swung far and wide. The autocratic employer of yesterday is more than matched by the autocratic employee of today. Our profession, along with a great mass of people, is in the arc of the swing, and must needs be on its guard.

If the world is to progress, the medical profession must render its best service, indispensable to the main groups of society. Are we perhaps not the very latent force that if properly applied, will do much to establish better relations between labor and capital, a new confidence between these warring factions, a better understanding on the part of each of the difficulties and purposes of the other. We can help close the gap—narrow the gulf—by humanizing industry. This approachment will come not by the fact that the physicians will act as mediators in any active struggle, but by daily furnishing human contacts on which better understanding and greater tolerance are created. In actual industrial practice the physician acts as the liaison force between employer and employee.

If such premise be sound, if any such hope of new human service exist, it behooves us as a profession to take inventory and better fit ourselves for this national reconstruction. We have still to demonstrate our worth. Our usefulness in public discussion of serious labor problems is not noteworthy.

Did it strike any of you as curious that the President did not include a member of our profession in his National Industrial Conference at Washington, which began on October 6?

Organized labor is given 13 representatives with four additional from the railroad brotherhoods, making 17 in all; the United States Chamber of Commerce, and the National Industrial Conference Board are each given 5 representatives; while the farmers' organization and the bankers' association are allowed 3 and 2 members respectively. One would gather from the above that the organized portions of society have their interests fairly well protected in this conference. Can we say as much for the public, which all too frequently finds itself squeezed by the pressure which any two contending forces happen to exert on each other?

It is interesting, therefore, to note which of the fifty-seven varieties of statesmen who have been appointed to the National Industrial Conference, are represented in the twenty-five individuals chosen to appear in behalf of the public. Unofficial record and *Who's Who in America* reveal the fact that the public is here represented by one broker; two bankers; two socialists, one a writer and the other, once an aspirant for public office in New York; one president of a farm bureau federation; a cotton manufacturer; a clothing manufacturer; three directors of large corporations; one attorney for railroads; one paper bag manufacturer; one wagon manufacturer; one editor of a farm paper; one designated as a lawyer and politician; another known as "potato king"; one indicated as oil operator and lobbyist; one woman publicist; two women social workers; along with John D. Rockefeller, Jr., Elbert H. Gary, of the steel corporation, and Dr. Charles W. Eliot, president emeritus of Harvard College.

The one issue that is not controversial in this conference is that of decent living and working conditions. Within this issue are bound up problems of shop sanitation, the question of working conditions, prevention of occupational disease and accidents, medical supervision with physical examination, to say nothing of the living conditions—housing and community health programming. These are factors in the industrial relations conference to which the physician, with his scientific training and social viewpoint, might have given invaluable suggestions, and yet we were, of all the professions, distinctly counted out. These are the things that make for the success, health, unity, and contentment of the people and are vital to national and international peace.

If production is the keystone of a world reconstruction, and if health and sanity be so large a factor in production, had we not better move the physician out of his private office and into industry? Here he will soon be less an individualist. He need not be less scientific, but he certainly will be more usefully scientific, as he touches elbows with those who rarely see or know the best that is in medicine or surgery. He will be applying to the great mass of workers—the backbone of the nation—that great storehouse of scientific knowledge and research which today is finding application in only a fractional part of the population.

It has become axiomatic that only the rich and the very poor get the best that we have to give as a profession. This fact becomes startling when viewed from the industrial clinic. Your hospital or medical college clinic only meets a fraction of the problem. You are working there with those who have fallen below the poverty line—too late to do preventive social work, often too late to do preventive medical or surgical work. And what a wondrous waste of energy, for only about 15 per cent of your clinical cases ever return for further observation. The clinic within industry prevents the unfortunate but good American workman from reaching the poverty line—it keeps him out of the charity class.

Within the past decade there has developed as a result of a strong demand on the part of industry, a new specialty to which hundreds of our profession are now devoting themselves. The industrial physician and surgeon is desperately attempting to cope with the manifold economic and social problems that are being brought to his attention. He is making himself familiar with the health problems of industrial institutions and those of the community. He is trying to make himself the master of the medical and surgical problems of industry, which I assure you are quite distinctive from those that the

general practitioner and surgeon meets. He must have knowledge of the sanitary standards of plants, of occupational diseases, the subject of fatigue, the principles of safety work; he must know how to approach the subject of the medical supervision of the employees, with special emphasis on physical examination, the proper placement of the employee, dental hygiene, and nursing service; he must have a real interest in the broad question of personal relations in industry, must understand employment methods, with the proper recording of absence, lateness, illness and injury, labor turn-over, and their bearing upon production; he must know the problem of the health of the employee in relation to the establishment funds, or "mutual aid associations" as well as the other factors of industrial health—recreation, food, cafeterias, rest periods, and so on.

The subject of lost time from work on account of illness, injury and other causes, is being continually related to the man's productivity and earning capacity, and in this way the physician's knowledge of medicine and surgery becomes a factor in economic life. It is the business of the industrial physician and surgeon to discover the existence of unhealthy working and factory conditions, —the matter of inadequate ventilation, lighting, drinking water, toilet and locker facilities. These things, along with the occurrence of dust, fumes, gases, poisons, overcrowding, unnecessary noises, excessive variations in temperature and humidity, some of which produce an impaired vitality and low output, are his daily concern. The subject of fatigue, along with monotony, speed, and overtime, all become the problems of the industrial physician, to be weighed in as factors in inefficiency and low earning capacity. Who can say how far fatigue brings on soreness of mind, and again how far soreness of mind predisposes to bodily fatigue? To what degree is that soreness of mind expressed in unrest?

When this type of work is well done, the physician becomes a social and medical engineer. He makes available to the mass of working men the best surgical and medical skill; he intensively educates the worker to the dollars and cents value of good health and personal hygiene; and finally, and perhaps most important, he gives the employer accurate knowledge of the social, economic and health conditions of the worker, otherwise unobtainable. He affords to the employing class, interest in and greater appreciation of the value of community health, and thus makes for the extension of public health control.

Out of this great human laboratory comes the conviction that the medical profession must square itself with the conditions that obtain in this industrial era. This experience spells a need for group diagnostic clinics, where the average worker may pay a reasonable charge for the best diagnosis. The industrial clinic, acting as a diagnostic clearing station, is continually sending to the physician and surgeon on the outside, cases requiring operative and medical procedure. Too frequently these cases are being charged out of proportion to their capacity to pay.

It may amaze you to know that the average worker receives his first complete physical examination in the industrial clinic. He is too often the victim of blind, gun-shot prescriptions. The industrial clinic is teaching him to seek a better type of physician for himself and his family, and in that sense the industrial physician is tending to raise the standard of private practice on the outside.

In attempting to secure this better medical and surgical attention, the inadequacy of hospital and clinical facilities to care for the man who desires no charity, but who deserves the profession's best service at his price, becomes apparent. Whether the workman can receive his just dues in this regard without the intervention of some system of social insurance, remains for our profession, in conference with political and social economists, to determine. Again we have a group problem calling for mass treatment.

The industrial physician is doing much to mold opinion in behalf of preventive medicine. He is intensively educating the worker to care for his health. Our mortality rates can only be further lowered by such type of work, for the public seems to have reached a saturation point in regard to the educational appeals

sent through the press by health departments. Industry can make use of the economic pressure to secure attendance to health matters.

The industrial physician recognizes not only the particular symptom of the patient in his clinic, but he visualizes through him the shop, the bench, the particular occupation, that is affecting him; the dirt, the danger, the monotony, the home environment of the man before him. His preachments for healthful living are readily translated into the fact that each day of illness means a cramped budget at home; that prolonged absence on account of preventable accident, is, through lowered production, adding to the cost of living.

It must be apparent that service of this type is more than mere medical or surgical service; that it is intensely conservative of the body and mind of the worker; that it humanizes his place of work; that it must change his attitude toward his job and officials in the plant; that it paves the way for clearer thinking and greater self-expression; that it substitutes personality for the mere dull cog in the machine; that it calls out character both in the employer and the employee; that we thus secure an improved mass morality in both groups, and hasten the day of the true spirit of justice and good will in industry, the day of a real democracy between men.

These are some of the problems that the physician and surgeon of the industrial era must meet. These are questions which particularly challenge the attention of this society, which has within its membership men with vision, who see things in a big way, who have shown an ability to do, who have developed a capacity for leadership. Your society has the power to sway medical and public opinion; you have the organization to carry out any plan to reach any goal you set for yourselves. It is for you to evaluate this new specialty—to institute appropriate courses in medical colleges; to further its wider extension in industry. Please remember that unless the task outlined for the industrial physician is accepted by him, there is no one else who can undertake the task.

It is for the medical profession at large to determine what place it will hold: whether in the swift current of thought, or in the quiet eddies; whether to stay on the edge of life, or close up to the great melting pot of human experience; whether to remain as spectators, or join in the struggle of progress; whether to rest in billet, or press on to the firing line, where men are fighting for life's goal.

The responsibility of leading the profession at large can well be left with this society. I refuse to believe that you will not use your tremendous influence in this industrial crisis to set the people thinking sanely; that you will not assist in placing the medical profession back among the people—the doers and the hewers; to reproduce the original place of the physician in society, that of priest, confessor, teacher and healer; that you will not help place our medical, surgical and philosophical service right out among the people—place it at the ignition point of life, where it can be consumed and help fashion into thought and being a national life commensurate with the standards of those who set up our great republic. The obligation is yours; the service asked, ennobling; the opportunity for enlarging life, immeasurable.

OBSERVATIONS IN FIVE HUNDRED CASES OF INJURIES OF THE PERIPHERAL NERVES AT U. S. A. GENERAL HOSPITAL NO. 11*

By Lieutenant Colonel CHARLES H. FRAZIER, M.C., U.S.A. and First Lieutenant SAMUEL SILBERT, M.C., U.S.A.

OF the 208,000 casualties in the American Expeditionary Force, there were in the general and base hospitals in this country in April, 1919, 3,000 patients with peripheral nerve injuries. Assuming that 15 per cent of the total admissions had been discharged by this time—a conservative estimate—there were altogether approximately 4,500 peripheral nerve injuries or 1.6 per cent of the total casualties.

With but few exceptions, the treatment of peripheral nerve injuries did not begin until the soldiers from overseas became patients on this side of the Atlantic. Obviously this was a problem which belonged to the reconstruction hospitals and not to the hospitals of the war zones. In more than 500 cases admitted to General Hospital No. 11, there were not more than 5 cases in which the nerve had been sutured overseas.

The Surgeon General recognized in the management of peripheral nerve injuries a problem quite distinct from that either of general or orthopedic hospital and authorized the organization of ten peripheral nerve centers, in as many general hospitals, to which all patients were to be transferred from the ports of debarkation or later from base hospitals, to which a number found their way with lesions of the nerves unrecognized at the time of their admission. In each of these peripheral nerve centers an officer, experienced in neurological surgery, was assigned and a consulting neurologist and equipment essential for examination and treatment were provided. As an additional recognition of the importance of the peripheral nerve problem, the Surgeon General approved the organization of a Peripheral Nerve Commission, selected the personnel, and issued instructions as to the scope of its work. Among other things this commission will prepare for the Surgeon General a comprehensive report dealing with the various aspects of peripheral nerve injuries and the results obtained by treatment.

It has been my privilege as consultant in neuro-surgery to the Surgeon General's office, to visit the clinics in many of the peripheral nerve centers, but the views herein expressed will be based more particularly upon the observations of between five and six hundred cases under my direct supervision at General Hospital No. 11 (Table I).

To systematize the preparation of the clinical records, printed forms were prepared, afterward adopted by the commission as the authorized form for all the peripheral nerve centers. A technique of examination was elaborated, special instruments were designed, and instructions were issued as to how the phenomena were to be elicited and recorded. Orders were issued that duplicate copies of all clinical records be furnished to the Surgeon General's office so that the Commission might have, as the basis for its final report to the Surgeon General, complete and uniform records of all peripheral nerve lesions standardized as to methods of examination and record.

SENSORY PHENOMENA

With regard to observations upon disturbances, we disregarded the theory of Head and his well known classification of "epicritic" and "protopathic" sensory loss. The subsequent experiments of Trotter and Davis[1] and later of Boring[2] proved the fallacy of Head's theory and disproved the idea that there are separate fiber systems for moderate (epicritic) and for extreme (protopathic) temperature, tactile, and pain sensibility. Furthermore, the clinical observations from the wealth of material, provided by the four years of war, may be cited in refutation of Head's classification. Lieutenant Cobb, from his review of the literature and from his study of the problems in our clinic, concluded that dissociations of sensation due to peripheral

[1] J. Physiol., 1909, xxxviii, 134.

[2] Quart. J. Exp. Physiol., 1915, x, 1.

*The views expressed in the observations recorded in this article represent those of my associates on the staff as well as my own. I am indebted to the cordial co-operation of Majors Learmonth and Spalding, Captains Ingham, Kraus, and King, First Lieutenants Arnett, Anderson, Baird, Behney, Buerki, Cobb, Hobson, Kennedy, McCutcheon and Silbert.

TABLE I.—TABLE SHOWING NERVES INVOLVED IN A SERIES OF 400 CASES

Upper extremity		Percentage
Ulnar	112	22
Musculospiral	99	19.9
Median	88	17.8
Brachial plexus	37	7.2
Musculocutaneous	13	
Facial	13	
Internal cutaneous	9	
Circumflex	8	
Radial	4	
Lingual	1	
Hypoglossal	1	
Suprascapularis	1	
Total	378	74.8

Lower extremity		Percentage
Sciatic	53	10.1
External popliteal	53	10.1
Internal popliteal	11	2.1
Anterior tibial	4	
Posterior tibial	3	
Lumbar plexus	3	
Small sciatic	1	
Anterior crural	1	
Musculocutaneous	1	
Total	129	25.8

nerve lesions arose from comparing stimuli, not only quantitatively different but qualitatively unequivalent. By varying the quantitative values of the stimuli, dissociations of sensations could be produced almost at will. In short they are artefacts due to lack of proper standardization of the examination. Hence, it became apparent that in the examination of disturbed sensation, standardized instruments had to be employed and the examinations conducted under uniform conditions. If the limb was cold at one examination and warm at another, there would be a difference of 0.5 centimeters to 2.0 centimeters in the ulnar and even 5 centimeters in the sciatic distribution.

Upon the adoption of standardized algesimeters and a uniform technique, it was found that in the examination of an individual case by different members of the staff the sensory charts were precisely similar (Fig. 1). The technique included:

a. An examination for tactile sensibility with a camel's hair brush, so pliable that the skin could not be depressed. Loss to tactile sensibility was indicated on the chart by lines representing the stroke of the brush.

b. Test for pain sense with an algesimeter with 15 grams' pressure, indicated when lost by large dots on the sensory chart (see Fig. 2).

c. Test for deep sensibility by an algesimeter with 1000 grams' pressure indicated when lost by small dots or solid black (see Fig. 2).

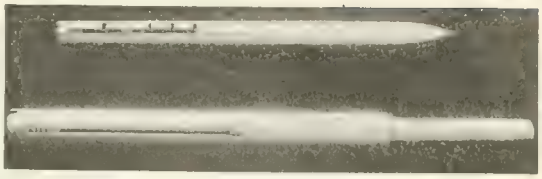


Fig. 1. Æsthesimeters devised at U. S. A. General Hospital No. 11 by Captain Ingham.

ELECTRICAL EXAMINATIONS

Electrical stimulation of muscles or nerves at the evacuation or base hospital is an invaluable aid in distinguishing the organic from the functional paralysis. In the reconstruction hospital where the patients are received 3 to 6 months after the injury, the value of the electrical examination is twofold: (1) to observe evidences of recovery, (2) to determine whether the condition is stationary or retrogressive. In recording the electrical findings, a special chart is used and instructions issued to all peripheral nerve centers as to how the findings are to be recorded (Fig. 3). We eliminated the terms "Reaction of Degeneration" as indicating conclusions rather than observations and instructed the examiner to record precisely what he elicited: (1) whether "faradic" contractions were "normal," "weak" or "absent," and (2) in the galvanic stimulation the rapidity of the contractions and relaxations and the presence or absence of reversals. By this system of record, comparisons could be made between examinations of different dates. The instrument supplied to all peripheral nerve centers was the Wappler galvanic and faradic plate. The investigation and interpretation of the electrical findings at General Hospital No. 11 is under the direction of Lieutenant Silbert, and the following are some of his deductions:

1. The loss of skin sensibility to faradic current is fairly good evidence of complete interruption. Tinel's observation that the return of skin sensibility is the earliest sign of nerve regeneration has been confirmed by the examinations in this clinic.

2. Occasionally the loss of skin sensibility is incomplete in cases proved at operation

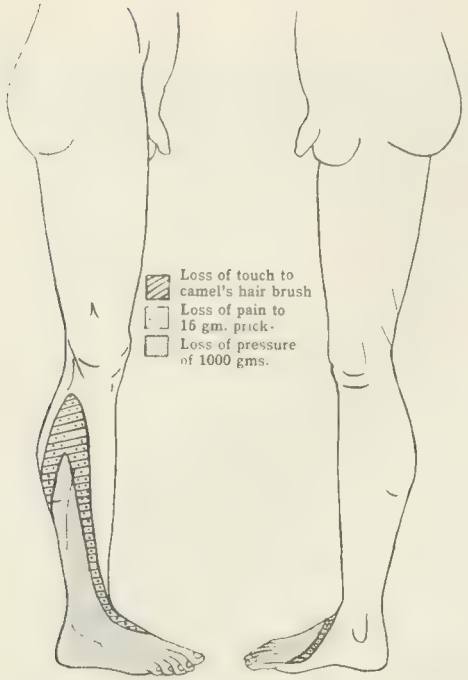
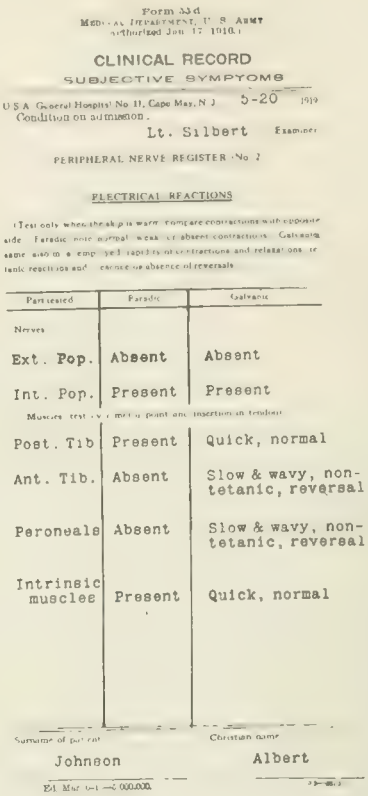


Fig. 2. Chart showing method of recording sensory examination.


Form 53d
CLINICAL RECORD
SUBJECTIVE SYMPTOMS
U.S.A. General Hospital No. 11, Cape May, N.J. 5-20 1919
Condition on admission.
Lt. Silbert Examiner
PERIPHERAL NERVE REGISTER No. 2
ELECTRICAL REACTIONS

Part tested	Faradic	Galvanic
Nerves		
Ext. Pop.	Absent	Absent
Int. Pop.	Present	Present
Muscles tested by motor point and insertion in tendon		
Post. Tib	Present	Quick, normal
Ant. Tib.	Absent	Slow & wavy, non-tetanic, reversal
Peroneals	Absent	Slow & wavy, non-tetanic, reversal
Intrinsic muscles	Present	Quick, normal

Surname of patient: Johnson
Christian name: Albert

Fig. 3. Chart showing method of recording electrical examination.

to be complete interruption. This phenomenon has been attributed to the presence of anastomotic communications between the nerves below the level of the lesion.

3. Faradic response may be lost even in incomplete and mild lesions, and such as those of moderate contusion, and is, therefore, of little value in a decision for or against operation. With but one exception in the operative series and in but three of all other cases did voluntary motion not return before that of response to the faradic current.

4. Stimulation by galvanism applied over the course of the damaged nerve uniformly fails to give a response in the muscles below the level of the injury.

5. The following deductions are drawn from the application of galvanism to the muscles supplied by the damaged nerve:

a. The maximum response is usually over

TABLE II. — SUMMARY OF ELECTRICAL EXAMINATIONS IN 100 CASES OPERATED UPON

	Faradic						Galvanic											
	Area of loss of skin sensibility			Muscle response			Nerve response			Muscle response								
										Slow			Tetanic			Reversal		
	Present	Absent	Not recorded	Present	Absent	Not recorded	Present	Absent	Not recorded	Present	Absent	Not recorded	Present	Absent	Not recorded	Present	Absent	Not recorded
Compression	1	[illegible]	6	0	13	0	0	13	0	0	0	1	1	5	1	1	4	5
Neuroma	20	17	1	0	32	0	0	30	0	30	0	2	6	30	10	11	38	3
Interruption	13	8	17	0	26	2	0	30	2	30	0	2	1	37	10	20	15	3

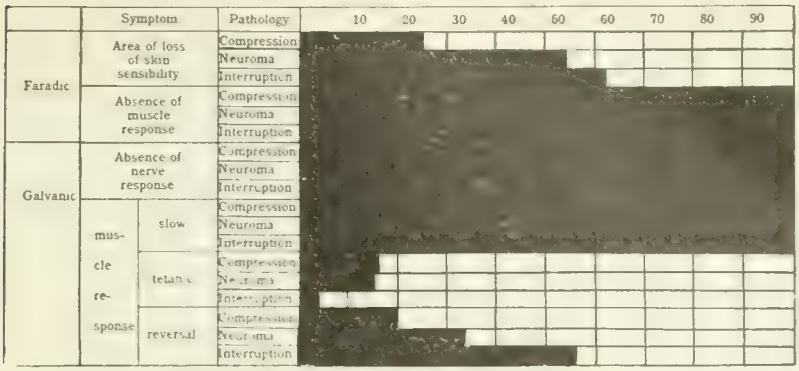


Table III. Summary of electrical examinations in 100 cases operated upon.

the tendon of the muscle or at the junction of tendon to muscle belly and not as in the normal muscle at the motor point.

b. The rapidity of contraction is the best guide to the degree of degeneration; the slower the reaction the more complete the degeneration.

c. Tetanic response is observed occasionally but its significance is not clear.

d. The reversal of polarity is the most valuable of all phenomena. Though not invariably yet in the majority of cases reversal signifies anatomical interruption.

e. Reversal of polarity is occasionally seen in normal muscles (see Tables II and III).

TROPHIC AND VASOMOTOR DISTURBANCES

Trophic and vasomotor disturbances of peripheral nerve lesions, are frequently observed but are of comparatively little practical importance, as affecting diagnosis, prognosis, or treatment. Capsular and muscle fibrosis are the most serious complications of peripheral nerve lesions and they are introduced in this connection because so often vaguely attributed to trophic influences. This disability arising from these two factors is extreme and unless relieved the regeneration of the injured nerve will avail but little. For reasons not clear the metacarpophalangeal joints are the most seriously involved. The cause of these crippling lesions in muscle and joint has been the object of an investigation in our clinic by Major Selling, and he has come to these conclusions: (1) In uncomplicated lesions there is no limitation of passive motion, except that which results from shortening of the paralyzed muscle, when the limb is properly splinted. This is of minor importance as the disability is soon overcome after the muscles have regained their function. (2) When nerve injury is complicated by fracture, prolonged immobilization and particularly by suppuration in the healing process, the result is often capsular fibrosis no matter what the nerve involved, whether musculospiral, ulnar or median. (3) If, however, there is a serious vascular lesion of the main arterial trunks, added to the capsular fibrosis, there is extensive muscle fibrosis and the combination of these is responsible for the extreme limitation of motion. The fact that in median and ulnar lesions of the arm, there is greater likelihood of involvement of the main arterial trunks accounts for the fact that these crippling deformities are seen more often in median and ulnar than in musculospiral lesions; and the same line of reasoning may be applied to

TABLE IV.—FACTORS INVOLVED IN LIMITATION OF MOVEMENT

1. Direct damage to joint and muscle.
2. Fibrosis and shortening paralyzed muscle.
3. Adaptive shortening normal muscle.
4. Capsular fibrosis.
5. General muscle fibrosis.

Nerve lesion	Limitation of Joint Movement
1. Uncomplicated	a. absent b. due to shortening of paralyzed muscles
2. Complicated by a. fracture b. immobilization c. suppuration	Capsular fibrosis Other factors secondary Capsular fibrosis
3. Complicated by vascular lesion	Extensive muscle fibrosis and shortening

TABLE V.—FACTORS IN JOINT LIMITATIONS IN A SERIES REPRESENTING THE MUSCULOSPIRAL, MEDIAN, AND ULNAR

Name	Lesion	Location	Fracture	Suppuration	Immobilization	Vascular	Elbow	Wrist		Fingers Limited Movt. Due to	
								Flex.	Ext.		
W. C.	M. S.	Arm	O	O	O+	O	O	+++	O	O	Wrist flexion, shortening of extensors.
W. C.	Med.	Axilla	O	O	O	O	++	O	++	O	Elbow direct injury. Wrist ext.; shortening of flexors.
P. H.	U.	Arm	O	O	O	O	O	O	+	O	Wrist ext.; shortening of flexors.
H. D.	M. S.	Arm	Humerus	+++	+++	O	+++	+++	++	++	Joint involvement (capsular fibrosis) all joints.
E. E.	Med.	Arm	Elbow	+++	+++	O	++++	+++	+++	+++	Joint involvement all joints. Elbow direct injury; others capsular fibrosis.
B. H.	Ulnar	Arm	Elbow	+++	+++	O	++++	+++	+++	++	Joint involvement all joints. Elbow direct injury; others capsular fibrosis.
H. H.	Med. Ulnar	Arm	O	+	++	Oblit. Brachial Artery	+++	+++	+++	+++	Joint involvement all joints Capsular fibrosis and extensive muscle fibrosis.

the lower extremity, where the most commonly affected nerve, the sciatic, is not accompanied with an injury of the large vascular trunks (see Tables IV and V).

PATHOLOGICAL CONSIDERATIONS

The pathology of peripheral nerve lesions was not overlooked in the turmoil of war, and of the noteworthy investigations mention should be made particularly of those of Cone and those of Huber, to whose direction the Surgeon General assigned the experimental study of nerve regeneration, as applied to nerve suture, and the minute examination of the pathological material removed at operation in the several peripheral nerve centers. The various types of lesions have been classified under five headings.

1. Complete anatomical interruption
   a. with central bulb,
   b. with central and peripheral bulb;
2. Neuroma in continuity
   a. central bulb;
   b. lateral bulb;
3. Partial anatomical interruption (lateral notch);
4. Sclerosis;
5. Compression
   a. by callus, bone spiculi,
   b. by aneurism,
   c. by scar tissue.

The pathological investigations in our clinic have been made, apart from the routine examination of specimens, chiefly along two lines; the topographical study of specimens removed with relation to the results of electrical stimulation on the operating table, and the distribution of motor and sensory disturbances and the correlation of pathological and electrical findings.

With regard to the latter, the complete and incomplete sensory, motor, and electrical findings have been tabulated in Table VI with relation to the three essential lesions: compression, neuroma in continuity and complete anatomical interruption. It is of interest to note that in the majority of instances a careful examination of motor, sensory, and electrical disturbances foretold the character of the lesion found on the operating table. Thus (1) in compression there was complete motor paralysis in 45 per cent, complete sensory loss in 15 per cent, and no case with complete reactions of degeneration. (2) In complete anatomical interruption there was complete motor loss in 100 per cent, complete sensory loss in 86 per cent and complete reactions of degeneration in 85 per cent. (The absence of complete sensory loss or reaction of degeneration in the minority may be attributable to the fact that in the scar tissue intervening between the divided seg-

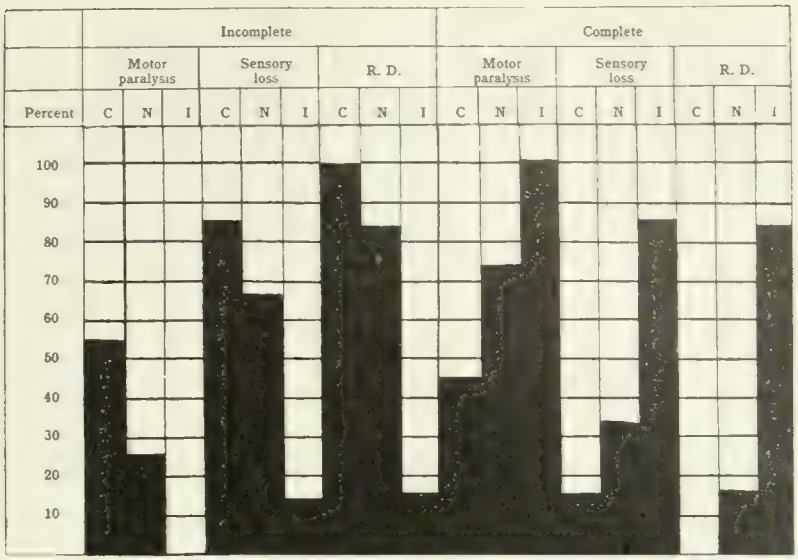


Table VI. Showing percentage of incomplete and complete motor, sensory, and electrical syndromes in compression, *C*, neuroma in continuity, *N*, and anatomical interruption, *I*.

ments a few indistinguishable fibers may have been present.) (3) The neuroma in continuity presented a picture, as one might expect, intermediate between compression and complete interruption. Thus there was complete motor loss in only 74 per cent, incomplete in 26 per cent; complete sensory loss in only 33 per cent, incomplete in 67 per cent; complete reaction of degeneration in 16.5 per cent, incomplete in 83.5 per cent.

TIME OF OPERATION

The determination when to operate is a matter of vital importance. Without fear of contradiction it can be assumed that the sooner the operation the better, but from indiscriminate, hasty resort to operation one must refrain for two reasons: (1) because many cases will recover spontaneously; (2) because the presence of an infected wound necessitates postponement. Looking at the statistics in our own clinic, we find that the first signs of recovery were not observed in a number of cases until 8 months after the injury (see Table VII). Of the recovering cases, 36 showed the first signs of recovery in the fifth and sixth month, and 26 in the seventh and eighth month. From these figures and those in the table it would be evidently unjustifiable to resort to operation, at least until six months had elapsed, and there might in view of these figures be some justification for waiting a month or two longer. The percentage of spontaneous recoveries may vary in different clinics. At General Hospital No. 11, taking the last 400 cases, 254 or 63 per cent had recovered sufficiently to be discharged or were in the recovery stage, 112 or 28 per cent had been operated upon and 9 per cent were stationary and unimproved (Table VIII).

TABLE VII.—SHOWING THE FIRST RECORDED SIGNS OF RECOVERY IN A SERIES OF 400 CASES

	Cases	Percentage
2 months	13	3
3 months	33	8.5
4 months	71	17.7
5 months	77	19.4
6 months	67	16.8
7 months	61	15.3
8 months	45	11.3
Over 8 months	32	8
	400	

Viewed from the standpoint of the condition of the wound, the advisability of waiting until the wound has been healed 3 months has been recognized as a wise precautionary

TABLE VIII.—SHOWING THE DISPOSITION OF A SERIES OF 400 CASES

Cases discharged		
Operated upon	3	
Not operated upon	125	128
	—	
Cases remaining		
Operated upon	109	
Not operated upon		
Improving	129	
Stationary	34	272
	—	—
Total		400

TABLE IX

Time it took wound to heal in a series of 100 cases	Cases	Time of operation if performed 3 months after wound healed	Percentage
1 month or less	126	4 months	31.5
2 months	90	5 months	22.5
3 months	74	6 months	18.5
4 months	36	7 months	9
5 months	26	8 months	6.5
6 months	17	9 months	3.3
7 months	6	10 months	1.5
8 months	6	11 months	1.5
9 months or over	19	12 months	4.7
Total	100		100.00

measure. This has been our practice, and the fact that there have been but three infections in over 100 elaborate, extensive and prolonged dissections, often through poorly nourished tissue and extensive cicatrization, would appear to justify the adoption of the three month rule. Two of these wound infections were superficial and could not have affected the process of regeneration at the line of suture; in one instance recovery has been complete. Applying the three month rule to our own cases (see Table IX) the time of operation would have been deferred to the end of the fourth month in 33 per cent of cases, to the end of the fifth and sixth month in 44 per cent, and to the end of the seventh and eighth month in 15 per cent. Apart from the interpretation of clinical phenomena as indicative of a complete physiological block, these two factors, the chance of spontaneous recovery and the three month rule, are often the decisive factor in determining how soon the patient should be operated upon.

METHODS OF PROCEDURE

Splinting. In the organization of a peripheral nerve clinic, provision must be made for the care of those cases in which spontaneous recovery has already begun as well as for those in which the necessity for operation is still under consideration. The importance of keeping the muscle in a state of rest was recognized long before the war and in lesions other than peripheral nerve palsies. It had been observed in the paralysis of anterior poliomyelitis that when muscles were kept at rest by proper apparatus, recovery of function was more prompt in the first place and in the end more complete. This general principle was recognized in the case of the peripheral nerve palsies, but there is a threefold purpose in the employment of splints. Not only is the muscle maintained in a state of rest, but overstretching of muscle and tendon is prevented and what is of equal importance, contraction and shortening of the antagonistic muscle is impossible.

In our clinic many of the splints employed were designed by Lieutenant Buerki, others were adopted from those in use in other clinics. The splints for musculospiral and external popliteal paralysis and for cases recovering from operation upon the sciatic or popliteal nerves were made after Lieutenant Buerki's designs (see Figs. 4 to 9). The splint for the median and ulnar paralysis was fashioned after the pattern of that used at the Walter Reed General Hospital and that for the brachial plexus palsies after the splint used at General Hospital No. 9. The essential features of a serviceable splint are these: it should be comfortable, light in weight, not cumbersome, of simple construction, easily removed and retained in position without bandages. All the splints in our clinic met these qualifications and were made in the splint room, by unskilled hands, out of heavy steel or copper wire. Especial emphasis is laid upon the avoidance of the bandage in the application of the splint because splints must be removed daily when the patient receives massage or while he is employed in the curative workshop.

Physiotherapy. In all peripheral nerve clinics the physiotherapy department is regarded as an essential feature of the organization and serves a useful purpose. While neither massage nor electricity can in the smallest degree prevent the atrophy of a muscle once its nerve supply has been interrupted, manipulation by massage and passive motion will aid in mobilizing joints that are restricted in movement for one cause or

Fig. 4.

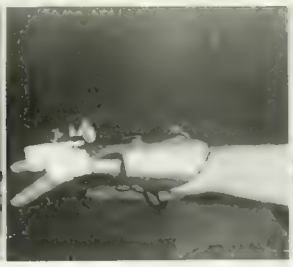


Fig. 5.

Fig. 6.

Fig. 4. Splint for musculospiral paralysis.
Fig. 5. Splint for ulnar paralysis.
Fig. 6. Splint for median paralysis.

another. Contraction of the paralyzed muscles by electrical stimulation is a valuable substitute for massage, and especially in the operative cases, it is of untold value from a psychological point of view, in that during the long and trying period, both before and after operation, the patient is content in the belief that by some magic influences electricity will restore power to the palsied limb.

For the recovering cases the curative workshop plays an important rôle. There is no doubt that purposeful movements are more effective in the restoration of function than calisthenics, passive movements, or massage. Furthermore the patient himself is much more content, his morale better, when his time is occupied in some form of occupation which maintains his interest.

Secondary débridement. In many instances it was necessary to postpone operation because of unhealed wounds. In many of these there was a chronic osteomyelitis. The postponement of nerve suture for weeks or months was, together with prolonged suppuration, prejudicial to the ultimate recovery of function. To hasten the healing of the wound, Captain King proposed a preliminary débridement with disinfection of the wound by the Carrel-Dakin technique, and when the wound was sterile, secondary closure, filling the defect if any, with a fat transplant. This plan of procedure was put in effect with the happiest result and final healing was secured in three or four weeks in wounds which, if left to the natural processes of repair, would have continued unhealed for as many months (Figs. 10 and 11).

In a paper which touches upon the problems of peripheral nerve lesions from so many angles, it will be impossible to include in the discussion of the technique the many details as they affect the individual nerves. The various steps of the operation will be reviewed as in its wider application and as practiced at General Hospital No. 11. To begin with the incision must extend well above and below the lesion. In the arm it is frequently necessary to make an incision from the axillary fold to the elbow or below, if the ulnar is to be transposed. The nerves must first be exposed and identified well above and below the lesion and then traced as far as possible through the entangling scar tissue. Frequently it is necessary to mobilize the nerve for a considerable distance above and below the lesion to secure approximation after resection.

Instead of towels as wound protectors, we have used a sterile sleeve slit the length of the wound and secured over the edges of the wound with Backus forceps. This enables the position of the arm to be changed, as is so often necessary, with greater facility than if draped with towels.

The dissection itself is one of the most tedious of surgical procedures. An abundance of scalpels is necessary since the edge is soon blunted by the dense connective tissue. While sharp dissection with the scalpel is to be preferred in general, we have found a small pair of eye tenotomy scissors convenient in freeing the nerve at the point it enters the dense scar tissue where it is difficult to distinguish between the two (Fig. 12). There are many objections to the use of the tourniquet and to avoid the necessity of constant sponging in order to keep the field clear, since oozing is

Fig. 7. Splint for deltoid paralysis.

Fig. 8 (at left). Splint for external popliteal paralysis.
Fig. 9. Splint for sciatic paralysis.

continuous, we have found a continuous stream of normal saline solution, directed precisely at the point of dissection to possess many advantages. The constant oozing is an annoying feature, constant sponging traumatizes the tissues and the continuous play of solution upon it keeps the field clear. When sponging is necessary, small pledgets of cotton should be used.

Electrical stimulation. Electrical stimulation of nerves on the operating table may serve a twofold purpose. Occasionally the identification of individual nerves in the upper arm or of roots or cords of the brachial plexus is facilitated by the use of the battery. But more frequently we have found it of service in deciding whether resection is or is not appropriate and how much if any of a given nerve may be conserved. Occasionally the external appearance of the nerve might not justify resection; if faradization of the nerve is followed by a response, resection would be clearly contra-indicated. If doubt still exists as to the propriety of resection we have in some instances split the sheath of the nerve and applied the electrode directly to the fasciculi. By this procedure we have been able to conserve some fibers which otherwise would have been sacrificed. Apart from the practical value of faradization we have been able to make, under the direction of Captain Kraus, interesting observations as to nerve topography. For example, we have found which portions of the circumference of the median nerve are purely sensory and might be sacrificed where it is desirable to use the median as a receptor for lateral implantation suture, as of the ulnar or musculospiral nerves.

Further interesting observations have been made as to the results of nerve stimulation of the peripheral segment after the nerve has been divided preliminary to suture. In one instance the musculospiral, clinically quite unreactive to the faradic and showing a partial reaction of degeneration (no reaction of the nerve to galvanism and slow contraction of the muscles without any polar reversal) gave, on stimulation of the distal end at operation, a definite response in the extensor indicis. In another instance the median nerve was found divided, but stimulation of the peripheral stump gave reactions in the flexors of the fingers and in the pronator radii teres. We shall need pathological confirmation of the absence of connecting fibers in the surrounding tissues. Another type of electrical response has been the presence of faradic reaction at operation but not clinically, with no visible discontinuity of the nerve present. A much stronger current is needed to bring about these reactions in diseased nerves than is needed to stimulate a normal nerve.

Resection. In the final analysis the success or failure of nerve suture depends upon

whether or not both central and peripheral segments contain healthy fasciculi free from the entanglements of adventitious connective tissue. The regeneration processes of nature are so well performed that given healthy fasciculi, regeneration will occur in spite of a clumsy suture. Hence all depends upon the judgment of the operator as to how much tissue is resected from either segment. The inclination is to resect as little as possible in contemplation of the difficulties in bridging the defect. But this must be disregarded and the criterion always must be the appearance of the nerve on cross section. With a safety razor, section is made at intervals of 2 to 3 millimeters until the appearance of the cross section is that of normal fasciculi. It is surprising how completely the picture will change, when the sections are made but 2 millimeters apart, from one in which the fasciculi are embedded in scar tissue to one in which there appears to be no scar tissue at all (see Fig. 17). The variation in the number of fasciculi in the central and peripheral segments is usually very great; there may be 8 or 10 in the central segment of a musculospiral nerve and only 3 in the peripheral segment. The actual resection should not be begun until all is in readiness for suture. All bleeding should be controlled, the bed of the nerve prepared and if stretching is necessary to aid in bridging the defect, this may be applied by traction on the bulbous ends.

Suture. The final approximation of the divided segments may be accomplished alone

Fig. 10 (at left). Wound after débridement and Dakinizing before suture.
Fig. 11. Wound after secondary suture.

by through-and-through tension suture or together with interrupted sutures in the perineurium. We have employed the latter technique striving to secure accurate opposition of the sheath in the belief that by so doing, the neuraxes will be directed with greater certainty from the central to the peripheral segment. One through-and-through chromic catgut suture is used as a stay suture to prevent tension upon the fine silk perineural sutures and at the same time

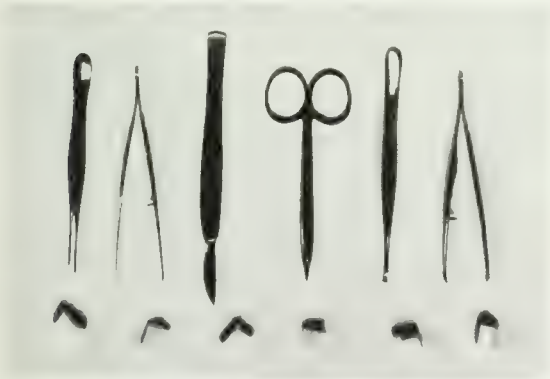


Fig. 12. Instruments used in nerve suture.

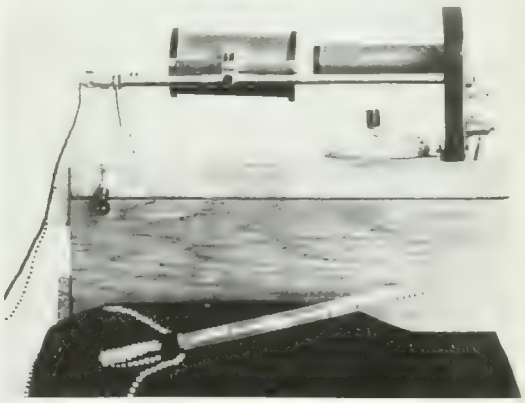


Fig. 13. Battery and electrode used in stimulation of exposed nerves at operation.

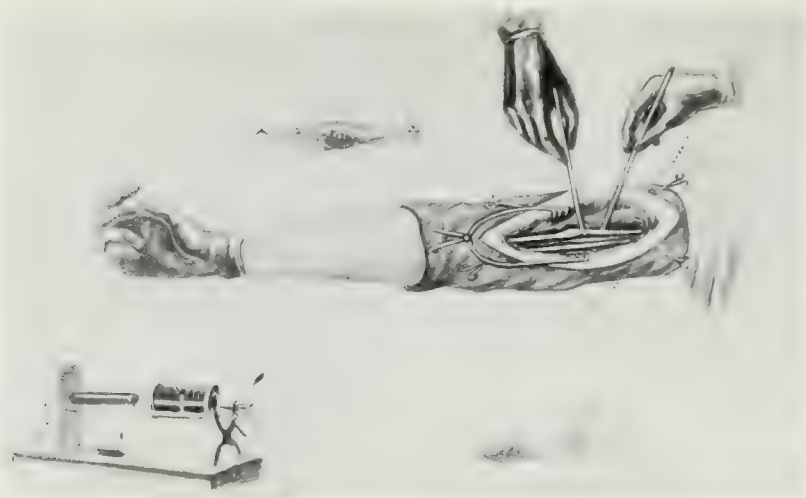


Fig. 14. Method of stimulating nerve exposed at time of operation.

to obliterate the space between the segments. If perineural sutures alone were used this space would fill with blood clot which when organized would offer a barrier to the passage of the new axis cylinders. Four to six silk sutures suffice to secure accurate apposition of the perineurium. There are two points in the technique of suture worthy of attention. In the first place the stay suture should not be tied, when there is any tension, untii the perineural sutures are introduced and tied. To tie the tension suture first will cause the fasciculi to protrude on either side and make it difficult to keep them within the sheath as the perineural sutures are tied. This may seem to be a minor matter, but by observing this precaution a real difficulty in nerve suture will be avoided. The second point has to do with the prevention of rotation in suture and the preservation of nerve pattern. Before the nerve is dissected from its bed guide sutures of silk are introduced at corresponding points on the circumference of central and peripheral segments (see Fig. 18). If this precautionary measure is not adopted the operator can never be sure that, after the two segments have been freed a considerable distance above and below the lesion, there will not be some rotation. Whether the avoidance of rotation is of real or only of theoretical importance might be open to discussion. Langley[1] is of the belief that accuracy in apposition is one factor determining the degree of recovery. By distortion of the nerve pattern the central nerve cells, which

Case No. Date of Admission

Name Rank Co. Organ.

General Hosp. 11 Reg. No. Date of Exam.

Home Address Age

DIAGNOSIS

Electrode Uni — Bi.

Level of Lesion Nature of Lesion

Level of Stimulation Operation

Level of Bifurcation Operator

Muscles Key X O	Result R	L

Black — Cephalad, Caudad, Post., Ant.
White Cephalad, Caudad, Post., Ant.

Pathological Findings

Fig. 15. Chart used in recording findings from electrical stimulation at operation.

[1] Brit. M. J., 1918, 1, 45.

Fig. 16. Shows method of sectioning nerve with safety razor.

formerly controlled only a flexor muscle, may, after suture and regeneration, control flexor, extensor, adductor, abductor or rotator muscles in various proportions. If a sensory filament unites with a motor there may be a functionless union. Hence it is concluded that any procedure which reduces disturbance of nerve pattern will make recovery more complete and will shorten the time taken to procure that degree of recovery.

With careful suture of the nerve sheath all forms of so-called protection to the line of suture are not only unnecessary but we believe undesirable. Fascia, fat, the use of Cargile membrane, increase rather than diminish the tendency to connective-tissue formation. A suitable nerve bed is desirable and the best is an intermuscular plane. The old bed of scar tissue or flaps of muscle tissue are both objectionable. When a bed in the normal strata is not available there is no objection to transposing the nerve to a plane between the superficial and deep fascia.

The wound should be closed with interrupted sutures, tier by tier, in muscle, fascia and skin, as far apart as possible, so as to permit of the escape of lymph and serum that would inevitably accumulate were the sutures too close together. With this precaution drainage will be unnecessary.

In most instances the limb, forearm, or leg must be retained in a position of flexion to relieve tension. This position is secured by a lateral plaster-of-Paris splint. It has been our practice to maintain the limb in the position in which it was placed at the time of suture for from four to six weeks, four in the upper and six in the lower extremity. The limb is gradually brought into extension during the succeeding four weeks. Daily massage is given from the day the sutures are removed and galvanism is applied at the same time.

After suture of the sciatic and popliteal nerves the plaster-of-Paris splint is removed at the end of the second week and a light wire splint substituted (see Fig. 9). This splint permits of flexion of the knee but not of extension beyond the desired point. When the time comes to begin extension, this is regulated by daily straightening the splint a little.

SUMMARY

While in this discussion it has not been possible to take up the technical details as

Fig. 18. Steps in technique of nerve suture.

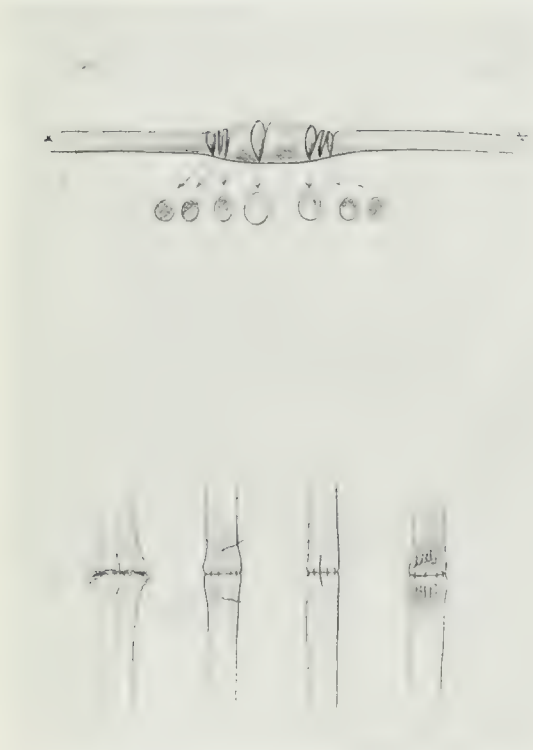


Fig. 17. Steps in technique of nerve suture.

applied to individual nerves, a summary is given in conclusion of the principles which have governed us in dealing with the problems applicable to all.

1. Liberation or neurolysis has been given preference in the absence of a complete anatomical division or a neuroma in continuity when after excising all scar tissue and laying bare the nerve sheath there is a quick response to faradism.

2. Resection and suture are essential whenever neurolysis is contra-indicated. Resection must be carried central and distalward until healthy scar-free fasciculi are exposed.

3. In bridging defects the nerve transplant must not be employed until advantage has been taken of every other reasonable measure: to wit, nerve stretching, immediate or continued (as with sutures through bulbs), mobilization, transposition as of ulnar and musculospiral, and in exceptional instances lateral implantation suture as ulnar or musculospiral into median.

4. When these fail a nerve transplant is justifiable, the autotransplant being the first choice, and homotransplant (preserved in vaseline, liquid petrolatum, or 50 per cent alcohol), the second choice. For autotransplant the musculocutaneous or sural nerves

Fig. 19. Patient with recovering paralysis of external popliteal nerve using jig saw for curative purposes.

of the leg, the radial or internal cutaneous of the arm, may be selected on the basis of convenience.

5. In nerve suture it is equally important to know what one ought not to do. In this category we include suture á distance, the flap operation, bilateral anastomosis (as recommended by Hofmeister) and tubulization.

6. Sharp clean dissection, careful hæmostasis, the approximation of healthy fasciculi, without undue tension, represent the tripod upon which the success of nerve suture rests.

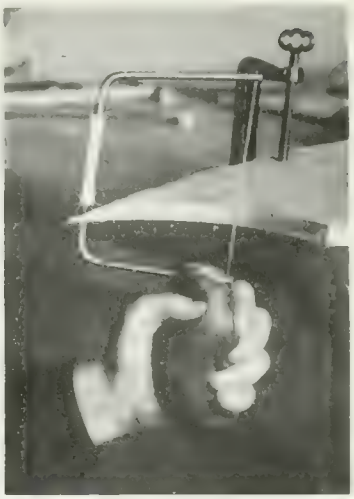


Fig. 20. Handle of saw made to fit paralyzed hand by means of modeling compound.

7. Tendon transplantation should be employed when suture fails and is particularly appropriate in residual palsies of the posterior interosseous, with inability to extend wrist or fingers, and anterior tibial palsies with resulting foot drop.

8. The after-treatment should include (a) enforced fixation for a period of 4 to 6 weeks with gradual straightening of the limb, (b) massage and galvanism until voluntary movement returns, (c) exercises varied according to the muscles involved and with a view of sustaining the interest of the patient.

CHRONIC TRIGONITIS IN THE FEMALE

A New Method of Treatment; Preliminary Report[1]

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"IRRITABLE bladder" in women may be due to several causes; some extrinsic, some intrinsic. Among the extrinsic causes may be mentioned pressure by the gravid uterus, and uterine, ovarian, or pelvic, new-growths; distortion by extravesical new-growths; displacements by cystocele and prolapse and following interposition operations on the uterus; congestion, from general pelvic congestion due to inflammations, pregnancy, etc. Among the intrinsic causes may be mentioned inflammations, cystitis, primary or secondary to renal disease; new-growths; foreign bodies, including calculi, etc. In the past, an irritable bladder with no gross findings and a clear urine, was, for want of more accurate diagnosis, labeled, a "bladder neurosis," but today we know that a true neurosis of the bladder is exceedingly rarely, if ever, found. Bladder symptoms due to nervous diseases are usually of a very different type; dribbling, loss of control and retention, but rarely, if ever, irritability. According to Garceau "stammering bladder" and "essential incontinence" may be bladder evidences of a psychosis, but the term "irritable bladder" should be dropped. But there is a large and common group of cases, in which the main symptoms are those of bladder irritability with a clear urine and no gross intrinsic or extrinsic pathology to explain them. In these cases, careful examination with the cystoscope will reveal definite changes in the trigone as the chief pathological feature, and to this group of cases we apply the term cystitis colli or trigonitis.

Anatomy. The floor of the bladder is divided into two distinct portions: a part of the fundus behind, and the trigone in front. The trigone is the triangular area lying between the urethra in front and the two ureteral orifices behind. The base line is 2 to 2.5 centimeters long, a slightly elevated ridge (ligamentum uretericum, muscle band of Bell, bar of Mercier). The lateral boundaries are formed by lines connecting the ureters to the internal urethral sphincter. It is smooth, moderately red in color and, as Walther so well describes it, "sharply marked off from the yellow sand-like shore of the adjoining bladder walls." It varies somewhat in different individuals, in some being long and narrow, in others approaching an equilateral triangle.

Historical. Trigonitis was first described as a clinical entity by Knorr in 1900 and subsequently verified by a host of observers. There have been some who have denied that this condition exists as a clinical entity, but there seems to be a preponderance of evidence in favor of the existence of this condition as such.

Frequency. Knorr found 80 cases in 400 cases in his clinic complaining of bladder symptoms. Furniss says: "It is one of the most frequent bladder lesions in females; 30 per cent of the cases in the gynecological department have bladder symptoms and fully 90 per cent of these have cystitis colli, or trigonitis." Carey says: "One of the most frequent causes of bladder irritability is trigonitis." And Pilcher: "Many cases of chronic cystitis resolve themselves into a chronic trigonitis which leaves the patient with an irritable bladder for some time . . . . . It is frequently met with in cystoscopic work."

Etiology. The exact causes of this conditions are not known. Age seems to be of little significance. It impresses me as being a little more common in women near the menopause but I have seen many cases in much younger women. Parity also seems to be of no account. I have seen numerous cases in nullipara and when we consider that the majority of women over twenty have borne children, I should say that it is relatively as frequent or more so in nulliparous as parous women. Of the parous women it seems to occur proportionately

[1] Read before the Section on Obstetrics and Gynecology of the New York Academy of Medicine, April 22, 1919.

no more frequently in those with cystocele than in those with normal bladder support. Pilcher says that a chronic cystitis frequently resolves itself into a chronic trigonitis, but in the experience of Carey and myself, the converse, that trigonitis is frequently the result of a preceding cystitis, is certainly not true. Carey claims that trigonitis generally begins insidiously without any preceding bladder or other disease, and I fully coincide with this opinion. Garceau and Walther believe that it may be an infection from the start or be an infection grafted on a hyperæmia due to pelvic engorgement from accompanying pelvic disorders. Kelly and Byford have ascribed it to a hyperacidity due to improper metabolism, but I have seen typical cases of trigonitis with an alkaline urine. There is no satisfactory evidence that the gonococcus plays any important rôle in its occurrence and most cases show no evidence of recent or ancient gonorrhœal infection. Colon bacilli and staphylococci have been found in the catheterized urine by Carey, but these are frequently found in the urine of perfectly normal female bladders.

Pathology. The gross appearance of the trigone in this condition will be dealt with below in describing the cystoscopic picture.

The literature contains few references to the histologic picture. In a case curetted by Garceau, the curettings were submitted to "a Harvard pathologist," and the following description is given: "Situated immediately beneath the stratified epithelium of the bladder are numerous lymphocytes massed together in an area to form an area similar to lymphoid tissue. A few lymphocytes are seen in the stratified epithelium, but these are very few. The stratified epithelium is well preserved in the specimen; it shows an occasional mitotic figure, but there is little evidence of inflammation in the stratified epithelium. In some areas the aggregation of lymphocytes is situated immediately beneath the bladder stratified epithelium and this epithelium is intact. This shows chronicity of the process. The trigone is on the whole, smooth. There is abundant evidence of subepithelial inflammation." Veit says: "There is round-celled infiltration, vascular proliferation, epithelial hyperplasia, desquamation and cyst formation. "Legneu describes it as follows: "Vascularization of the mucosa, epithelial cyst formation, and even leucoplastic transformation of the epithelium. At first there is a local hyperæmia contrasted with the normal bladder mucosa, later a thickening of the mucous membrane even to proliferation and formation of papillæ and warts."

Symptomatology. The onset is generally insidious with gradually increasing frequency of urination, especially by day, but somewhat also at night. With this there is usually no pain, but at the end of the act of urination there is generally a sensation of incompleteness and a desire to pass more. The patient will empty her bladder and within two or three minutes have an uncontrollable desire to urinate again, which usually, if yielded to, accomplishes nothing, or at most only a few drops are expelled. There is an almost constant desire to urinate and many patients complain that by day they are obliged to relieve themselves as often as every 5 minutes, voiding only a few drops each time. As this condition progresses the patient becomes more and more miserable, all work, meals and even sleep are interfered with and the patient is obliged to devote her entire time to emptying or trying to empty her bladder. In these later stages there may be some pain, but it is rarely very severe, and, occasionally, there may be a slight terminal hæmaturia. The chief complaint of these patients is the constant desire to urinate and the sensation of never completely having relieved themselves.

Course and prognosis. Furniss says: "It may last for years"; and Sommers: "With remissions it may last indefinitely." Garceau mentions a case that continued for 10 years, and the patient was in a pitiable state for loss of sleep. Fortunately these severe cases are not very common. But almost every patient states that she has had these symptoms for years and that they are gradually but progressively increasing.

Cystoscopic findings. The bladder capacity is generally considerable, often large, and the walls outside of the trigone of a normal pink-

ish yellow color with clearly defined branching blood vessels; occasionally there appears to be a moderately increased vascularity. If the cystoscope be pushed well into the bladder then turned to bring the base into view and gradually drawn forward, we get a view of this normal bladder wall up to the posterior limit of the trigone where we come to an abrupt change sharply demarkated by the interureteric ridge. In front of this ridge the mucosa of the trigone is swollen, dark red, intensely angry looking, and cloudy. The vessels are usually fine and small and can be seen extending backward almost parallel to each other but their contour is far less distinct than in the remainder of the bladder wall. The normal yellow mucosa cannot be seen between the vessels as in simple hyperæmia. (Knorr.) Scattered red spots which resemble ecchymoses may be seen (Garceau). I have frequently noticed small red spots especially toward the posterior limit of the trigone which appear slightly raised and are sometimes very close together. They vary in size from mere specks to a poppy seed and the trigone appears to be studded with little knots of very dark red silk. The mucosa is distinctly thickened and velvety, and as Walther says "a catheter sinks into it revealing rosy, satiny, non-transparent hypertrophied papillæ." Knorr claims that occasionally minute cysts may be present. Not infrequently the papillary hypertrophy proceeds to formation of small polypi (Legneu). Carey claims that the trigone bleeds easily at a slight touch of the cystoscope, but I have not been able to verify this. I find that the trigone in trigonitis is particularly resistant to trauma and can be made to bleed only with difficulty. Whitish or yellowish white areas in the congested region due to cellular metaplasia are rare, but these cases are particularly intractable to treatment in the opinion of Furniss and Carey. This I am able to confirm but can report very encouraging improvement in the two cases of this nature which I have had opportunity to treat by the method here described. The posterior part of the sphincter and frequently the adjacent portion of the urethra are similarly involved, and at times small fissures occur in the sphincter. With the cystoscope at close range and short focus, the mucosa can be seen to be extremely thick, velvety, translucent, almost œdematous, and this appearance is especially well brought out if a fold of the mucosa is caught and lifted on the point of the needle. The ureteral orifices are generally normal in appearance.

TREATMENT

Rest in bed, diet modifications (Byford) bladder irrigation and installations have all been tried with varying degrees of temporary success. Hunner has advised the continuous bath. The consensus of opinion is that the treatment proposed by Knorr gives the best results of any so far proposed. Knorr's latest treatment is as follows: rest in bed, light diet, forced fluids, hexamethylenamine, santol and boric acid by mouth. After irrigation with bland fluid, 20 cubic centimeters of eucaine solution 2 per cent is introduced through a catheter into the bladder, and as the catheter is withdrawn, into the urethra. Anæsthesia develops in from 2 to 5 minutes. A tubular endoscope is then introduced and the bladder drained and mopped dry with sterile cotton-wound applicators. A similar applicator with silver nitrate solution 1 to 5 per cent is then introduced and the endoscope withdrawn. The bladder contracts in a spasm on the applicator squeezing out the silver solution over the bladder floor. The applicator is withdrawn after 30 seconds, thus at the same time medicating the urethra. Garceau elaborates this treatment as follows: In addition to carrying out Knorr's treatment, polypi should be removed with snare or cautery, fissures should be dilated and touched with silver nitrate fused on a probe, cysts should be punctured with the electro cautery, and ulcers cauterized with silver nitrate solution, 10 per cent. If this treatment fails a vesicovaginal fistula may be formed at the vesical neck and the trigone scrubbed with a tooth brush, the bristles of which have been cut short in order to render them as stiff as possible, or the trigone may be curetted. He acknowledges that the results of this ultraradical treatment have not been satisfactory. Kelly, in dis-

cussing Garceau's paper, stated that he had attempted injections of novocaine into the vesicovaginal septum but with no benefit. I have used Knorr's treatment repeatedly and am obliged to state that the results have been far from satisfactory. Treatments are necessary two or three times a week, repeated over a long period of time, sometimes for as much as 6 months. Some relief is usually obtained, but there is almost bound to be a recurrence not long after cessation of the treatment.

For this reason, in 1916, having several of these patients under my care in my clinic, I attempted to devise a treatment that would give better results. Very little was to be found in the literature concerning the etiology or pathology of this condition, but the outstanding feature of the cystoscopic picture was the intense congestion, hypertrophy, and hyperplasia of the subepithelial blood vessels and the swollen mucosa. Could anything cause the destruction or at least constriction or compression and thereby reduction in size and possibly in number of these blood vessels? I knew that quinine and urea hydrochloride solution when injected into the tissues for production of local anæsthesia frequently, especially in strength of over 1 per cent, caused a deposit of fibrin and a considerable induration at the point of injection, which induration not infrequently remained for months. Constriction of the vessels in the tissue must result, to what extent remained to be investigated, but I had personally observed a complete gangrene and necrosis of the terminal phalanx of the thumb where 2 per cent quinine and urea hydrochloride had been injected at the base by the Oberst method, and a ring of indurated tissue remained at the site of injection for weeks. Evidently this ring of deposited fibrin had so constricted the vessels that the circulation was interrupted and gangrene ensued. I therefore decided to try injections of this solution into the trigone, beginning with weak solutions to observe the effect, not knowing but what strong solutions might cause necrosis of the mucosa, and gradually increase the strength if no harm resulted. In my earlier attempts I used a Kelly cystoscope, electrically lighted, with the patient

Fig. 1. Electrically lighted Kelly cystoscope and original needle.

in the knee chest position. I had a special needle constructed similar to the one illustrated (Fig. 1), but shortly found that the needle was so frail that it wobbled and could not be introduced at the desired point. Furthermore the needle was so flexible that, when pressure sufficient to make it enter the tissues was made, it bent and doubled and accuracy of manipulation was absolutely impossible. Then by degrees a needle was evolved for use with the Brown-Buerger cystoscope and with this I succeeded in making my injections and obtaining results that were most gratifying. The technique is not easy, in fact, quite difficult, and it has been only after repeated efforts that I have finally succeeded in making the injections where desired. Very little pain is given the patient and if she be reasonably tolerant a fairly large area can be injected in one sitting. Usually, however, several treatments, three to six, are required, but the relief from even the first treatment is so prompt that the patient readily consents to another sitting.

Description of instrument. *A* in Figure 2 is a long flexible needle of No. 28 gauge fitted with a threaded end for attachment to a hypodermic syringe or preferably to an adapter which fits an all glass syringe with a slip joint. *B* is a hollow cannula of inside dimension just sufficient to allow the needle to pass through it without binding. The outside dimension is of about the caliber of an ordinary ureteral catheter. It is made of the same tubing that is used in "reinforcing" hypodermic needles. At the proximal end there is attached a small

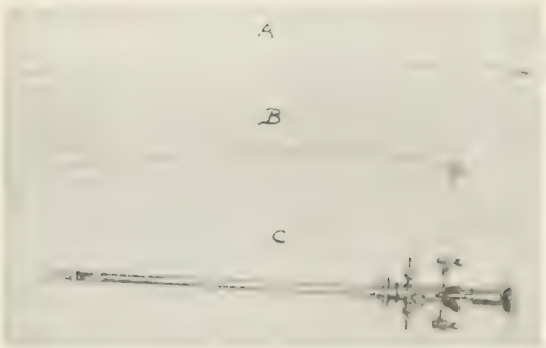

Fig. 2. Brown-Buerger double catheterizing cystoscope, needle and cannula. *A*, Needle; *B*, cannula; *C*, cystoscope.

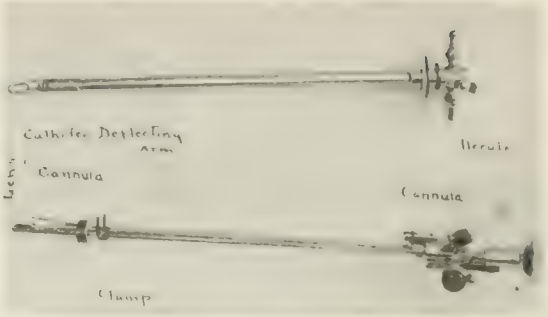

Fig. 3. Above, Brown-Buerger cystoscope sheath. Below, catheterizing telescope with cannula and needle in position for introduction into sheath. Note that the point of the needle is within the cannula and that the latter is held by the clamp so that the distal end lies on the catheter deflecting arm.

metal tab to serve as a finger grip. I found that if I attempted to introduce the needle without this protecting cannula the needle point would catch and bend against the movable directing arm of the cystoscope.

Technique of injection. The patient is prepared as for an ordinary cystoscopy and ureteral catheterization, about 200 cubic centimeters of sterile water being left in the bladder.

The instrument is sterilized in the usual way, the needle and cannula are boiled. The cannula is then fitted into the catheter channel (right or left) of the catheterizing telescope and pushed on until the distal end rests on, but not beyond, the movable catheter directing arm (Fig. 3). With the cannula in this position the needle is threaded through it until the point of the needle lies just *within* its distal end.

The cystoscope is then introduced into the bladder, the obturator withdrawn, and the prepared catheterizing telescope inserted. If necessary more fluid can be allowed to enter the bladder. With the light turned on and under the guidance of the eye, so as to avoid any possibility of injury, the cystoscope is pushed on into the bladder, rotated until the lens is down (faces the trigone) and the ocular end depressed until the vesical end can be seen to have been elevated well away from the bladder floor. The cannula is then pushed forward until the distal end enters the field of vision. The needle is now pushed forward through the cannula until the point is well into, but not beyond, the field of vision. Holding the needle in this position the cannula is withdrawn until well out of the field of vision (Figure 4). This will leave about one-half inch of the needle free beyond the cystoscope sheath, and lying flat against the directing arm entirely within range of the eye and under constant observation and control. The cystoscope is now manipulated to bring the trigone into view, the point of injection determined, the directing arm controlling screw turned, elevating the arm and directing the point of the needle downward toward the trigone (Fig. 5). The syringe filled with the solution is then attached to the needle and some of the solution ejected until seen to flow in a fine blue stream from point of the needle indicating that all air and water have been expelled. The needle is then made to enter the trigone at an angle, at the point desired, by manipulation of the cystoscope and two or three drops of the solution injected. A blue weal, sharply defined, will be seen to form. Should the blue fluid escape at the point of puncture it will indicate that the orifice at the oblique point of the needle has not completely entered the tissues. The tissue is soft and elastic, and can be seen to push ahead of the needle as the latter enters it. The whole point of the needle may disappear from view in this velvety mucosa and give the impression that it has entered the tissues. But when the blue solution is forced through if it is seen to float off in the surrounding fluid it is proof the needle point is not buried.

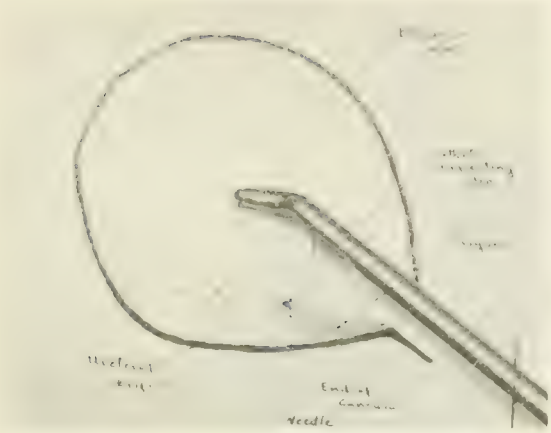

Fig. 4. The cystoscope in the bladder, first position. Note that the ocular end is depressed and the distal end elevated well away from the bladder floor. The needle point has been pushed beyond the end of the cannula well into the field of vision.

Fig. 5. The cystoscope in the bladder, second position. Note that the cannula has been withdrawn, the needle pushed on still further and the catheter deflecting arm elevated bending the flexible needle toward the bladder floor.

The needle is then withdrawn and entered elsewhere until as much of the trigone as is desired is infiltrated. I generally begin close to a ureter and work across the trigone in a line, and then work back across the trigone a short distance in front of this line. This is continued as far forward as desired. It is advisable not to make the injections too close together. On seeing the weal form about the needle in the form of a circle the next site of injection should be so chosen that each new weal formed will abut on the one preceding it. I begin at the posterior margin because blood rises as a screen from the punctures and obscures the field; therefore by working forward we keep in front of this screen. Of course hot continuous irrigation will tend to check the bleeding and help keep the field clear.

Solution. This consists of a sterile 2 to 3 per cent solution of quinine and urea hydrochloride in normal saline. It is colored rather deeply with methylene blue. For convenience I keep the solution in ampoules of 5 cubic centimeters. In future I shall add a small amount of a suprarenal extract to the solution in the hope of reducing the oozing.

For intravesical anæsthesia preliminary to fulguration of polypi, removal of specimens, dilatation of ureteral orifices, etc., for which this instrument readily adapts itself, I would recommend that weaker solution be used. These strong solutions are not necessary for anæsthesia, the weaker will answer just as well and the infiltration and danger of possible necrosis will be avoided. Other solutions than quinine and urea hydrochloride may also be used.

Site of injection. As described above, I begin near one ureteral orifice and work across the trigone, then in a second line back across to the side at which the start was made. This is continued to and into the sphincter and even the posterior urethra. Ordinarily four or five injections will be sufficient for the width of the trigone and only about four or five rows from behind forward are necessary. It is remarkable how little discomfort the treatment occasions, but it is even more remarkable how great, although temporary, a relief can be brought about by an injection of only 2 or 3 minims just in front of each ureter, leaving the balance of the trigone entirely untouched. This is probably a direct result of the anæsthetic effect of the quinine. It may be more convenient to use the convex or close vision cystoscopic sheath for the injections near the sphincter and in the adjacent urethra, but I have not found it necessary. The catheter deflecting arm, when

elevated, will generally push the mucosa away from the lens sufficiently to give a clear view.

Are there any dangers to this treatment? In answering this question I would say that there is undoubtedly a slight danger of necrosis and ulceration of the mucosa. This has been known to follow the use of quinine and urea hydrochloride solution elsewhere in the body and is certainly a possibility here. For this reason my first experiments were made with very dilute solutions. But no harm resulted, and I have now made probably fifteen or twenty injections of the 2.5 per cent solution, and have recystoscoped most of these patients a few days later, and have yet to see one single untoward result.

On one occasion early in my work with the Brown-Buerger instrument I was unfortunate enough to break off a piece of needle three-quarters of an inch long in the bladder. But with a Kelly cystoscope and an alligator forceps I had no trouble in removing it. This is the only mishap I have had.

Results. These have been most encouraging but, owing to the general upset in the clinic due to the absence of my first, second, and third assistants who were in service and the shortage and frequent shifting of nurses on account of the war and epidemic, all of my records have been either mislaid or thrown out. I can therefore cite but one typical case, that of a private patient, and give a general outline of my observations and impressions.

Mrs. I. D., age 30; violinist. The patient had typhoid in 1914. The menses were always regular, four-weekly, and painless. She has been married since 1911. She has no children, but had one miscarriage at 2 months shortly after marriage, at which time she was curetted, and had a slightly febrile convalescence. She miscarried again in September, 1915. The ovum projected from the cervix. It was extracted by me. She was not curetted, and had an uneventful convalescence. Complement fixation test was negative for gonorrhœa and syphilis. She first consulted me for bladder symptoms four months later. For the past two weeks, the patient had suffered day and night from frequent urination. There was slight burning at the end of the act with an urgent desire to urinate again. The urine was clear. The uterus was small, hard, retroflexed, but freely movable. A Smith pessary was inserted and a mixture of sodium bicarbonate and belladonna prescribed. This relieved the burning at the end of urination, but the frequency continued.

In June, 1916, the patient reported as follows: Urination every two hours and oftener by day, with sensation of bladder always being full, no burning. Urination twice at night, about 3 and 6 a.m. A specimen of urine was absolutely negative. A cystoscopic examination was made one month later. The capacity of the bladder was large, the fundus negative. There was a marked velvety and granular appearance of the trigone and marked congestion. The patient then disappeared from observation, until February 15, 1919. She then stated that since her last visit her bladder symptoms had become markedly worse. She was obliged to urinate every half hour during the day, and five or six times during the night. There was a constant sensation of the bladder being full and a constant desire to urinate. At times this became most urgent and she was compelled to yield to the desire, but she obtained no relief. There was no pain. This urgent desire to urinate was most annoying and interfered greatly with her vocation as violin soloist.

A catheterized specimen of urine was clear, amber colored, acid, specific gravity 1.011. Albumin, sugar, acetone and bile pigments were absent. Indican was normal in amount. There were no casts; cylindroids; mucous, amorphous, or crystalline deposits; pus, red blood cells or bacteria. There were present a few squamous cells.

Cystoscopic examination, February 18, 1919, showed the condition to be practically the same as at the previous examination except for the presence of two or three lentil-sized, pale yellowish patches. These were probably areas of metaplastic cell proliferation. At this examination the trigone close to the ureters and these patches were injected with 2 per cent quinine and urea hydrochloride solution but owing to the constant oozing and clouding of the field, treatment was not completed.

Two days later the patient reported that she had complete relief and for the first time in three years was comfortable and had been able to sleep through an entire night. She then went on a concert tour and did not report again until April 4. She then stated that she was greatly relieved for several days when the condition gradually recurred. She is not as uncomfortable as before, urinates only every two hours during the day and about twice at night. There is still a sensation of the bladder being full but, after urination, the sensation of incompleteness is entirely relieved.

On April 7, cystoscopy showed the trigone to be about the same as before except that the patches were white instead of yellowish, and the site of the previous injections stood out yellow, like normal bladder wall, with a few small vessels coursing across them, and surrounded by the intensely congested trigone.

The entire interureteric ridge, the trigone and sphincter were infiltrated with quinine and urea hydrochloride solution 2.5 per cent. Only a few

small areas were omitted. The oozing was controlled by hot irrigation. The patient, a few minutes after the treatment, said that she felt greatly relieved.

On April 22, fifteen days later, the patient reported that she was completely relieved of the feeling of fullness, the sensation of incompleteness, and the urgency. She still had to urinate during the night, but generally only once, and only about every three or four hours per day.

There have been no bad results, no failures, even at the very beginning when I was using only 0.5 per cent solutions and the Kelly cystoscope. The patients acknowledged that they had received instant relief, but that it had lasted for only a few hours or at most three or four days. After the stronger solutions were used the relief was again instantaneous but of considerable duration. I believe that the instantaneous result is due to the anæsthetic effect of the solution, the prolonged result to the destruction of the vessels and nerves by the pressure of the fibrin deposited about them. I wish to emphasize here that this solution is not used as an anæsthetic—such effect could at best be only temporary—but I am using and advising the use of this particular solution because it is known to cause a marked infiltration of the tissues with fibrin which will compress, obliterate and destroy the vessels and probably also the nerve fibers which pass through it. It is in this way that necrosis occasionally occurs when quinine and urea hydrochloride are used elsewhere in the body. Some day necrosis in the trigone may result from one of these injections, but so far I have not seen such an occurrence. The infiltration does occur, and that is exactly what I want. It seems to have no ill effects. How long it remains I do not know and apparently that is of little consequence. However, it does cause a disappearance of the excessive vascularization of the trigone and the symptoms of bladder irritability and this is the end sought.

Several of the patients came back once or twice to report marked improvement, and stated that they were so well that they "didn't need further treatment." Several allowed themselves to be recystoscoped that I might observe the results and in each case the area of injection was plainly discernible for long periods after. The areas where the weal had been stood out as a pale yellow spot, resembling almost normal bladder wall, surrounded by the diseased, angry looking mucosa. Strange to say even though the area injected was only a small part of the trigone much relief was experienced. One patient who had had several treatments during which the entire posterior half of the trigone was injected kept herself under observation for about three months. During this time she was perfectly well. I have not heard from her in over a year but I think I may safely say that, considering the good result in her case for which she was most grateful, she would probably have returned for further treatment had there been any recurrence.

On the whole I have been very favorably impressed by the practically unanimous verdict of these patients that they had been greatly relieved for a considerable period of time, a result that I had never been able to obtain with Knorr's generally accepted method.

Owing to the upset in my clinic and the extra work placed on me by the war conditions I have been unable to pursue this work to the extent that I had hoped. I realize that the cases are few in number and have not been observed steadily nor long enough for reliable or final conclusions. I do not wish to recommend this treatment as infallible nor appear too sanguine as to the results, but I personally believe that it gives promise of holding out to a marked degree distinct prospects of relief from this extremely intractable and miserable affliction. I, at least, and I hope others, will continue investigations along this line, until experience in a much larger number of cases gives us data that are really worth while accepting.

In conclusion I wish to sincerely thank my assistants, and especially Drs. I. Kross and A. Unger, for their kind assistance in the furtherance of this work and J. E. Kennedy & Co., for kind suggestions and co-operation in the development of the needle and cannula.

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THE DEEPER STRUCTURAL CHANGES ARISING FROM VARICOSE ULCERATION

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WHILE it is well known that varicose veins of the leg regularly cause an impaired nutrition of the skin and subcutaneous tissues, which readily become ulcerated, the fundamental changes in other structures remote from the ulcers are not generally recognized. And yet these changes quite regularly accompany the process when this is of long duration, and are so striking and significant as to deserve emphasis. It is quite to be anticipated that the tissues underlying an excoriation of the skin should be infected to a greater depth than the level of the granulation covering the floor of the ulcer. Especially would this be apt to be so when the ulcer became chronic. If then it occasionally happened that the bone immediately underlying such an ulcer showed signs of involvement, it would excite little or no surprise. We might expect a mild grade of local periosteitis, indeed, beneath most chronic ulcers. But this is not what happens, and it is most unusual for a periosteitis or osteomyelitis to localize beneath even an ulcer of moderate depth. Instead we have far-reaching changes. The tibia or fibula, and usually both, are involved in a periosteitis and osteomyelitis so diffuse as to extend throughout the entire shafts and involve even the epiphysis, so chronic as to pass unnoticed by the patient and occasion little or no pain. The inflammatory process which results in the most extreme structural changes never apparently reaches the stage of abscess formation, and if suppuration exists its products are absorbed into the system. Accompanying this are widespread vascular changes. The deep vessels, posterior tibial and peroneal, show marked calcification, which extends to the popliteal or above. This sclerosis occurs independently of the site, size, and depth of the ulcer, but is most marked in those cases in which ulceration has been present for a very long time.

Such striking changes occurring with regularity in a large series of cases and not dependent upon any discoverable constitutional disease at once arouse a question as to their mode of production. So far as concerns the bony changes it might be supposed that bacteria working into the depths of the wound invade the periosteum and travel beneath this to remote portions of the bone. This hypothesis fails, however, to explain why there are often little or no signs in the X-ray of bone involvement just beneath the ulcer, whereas the changes may be marked at the other end of the bone.

Furthermore, it becomes obvious that this is not the mode of production, when we find that the process is not confined to the bone over which the ulcer lies, but that changes of equal extent are present on the opposite side of the leg. Thus, we may see an ulcer over the inner aspect of the tibia with pronounced

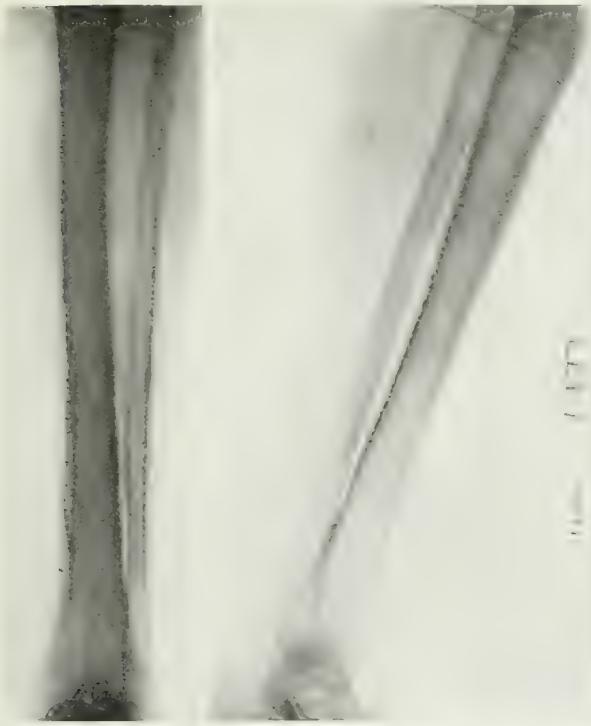


Fig. 1. Case 1. Roentgenogram of left leg showing slight diffuse periosteitis; no calcification of vessels. Marked varicosities but relatively slight ulceration.

Fig. 2. Case 1. Roentgenogram of right leg showing marked osteitis of fibula and some involvement of tibia. Calcification of posterior tibial vessels.

osteitis of the fibula. Some more general distributory agent than the cellular tissue must operate to produce such changes.

The solution of the problem is probably furnished by the extensive vascular changes which quite regularly accompany these cases. The advanced arteriosclerosis of the tibial and peroneal vessels, which appear in nearly all the X-rays as calcified tubes, indicates that the pathway of infection has probably been here.

This condition of the deep arteries of the leg at once arouses the thought that the logical method of bacterial distribution to remote parts of the bone is via the arterial wall and the adjacent lymphatics. The mechanism then would appear quite simple and be somewhat as follows: The lymphatics draining the ulcerated area sooner or later become the seat of a chronic lymphangitis which extends proximally, not only via the superficial lymphatics to the femoral nodes, but also via the deep lymphatics which

Fig. 3. Case 1. Ulcer of the posterior crural region of the right leg, of five year's duration.

Fig. 4. Case 2. Superficial ulcer of anterior crural region of right leg. The ulcer has been present at intervals for 20 years. Slight excoriation of the left leg has been present for one year, with marked eczema and extensive varicose veins of both legs.

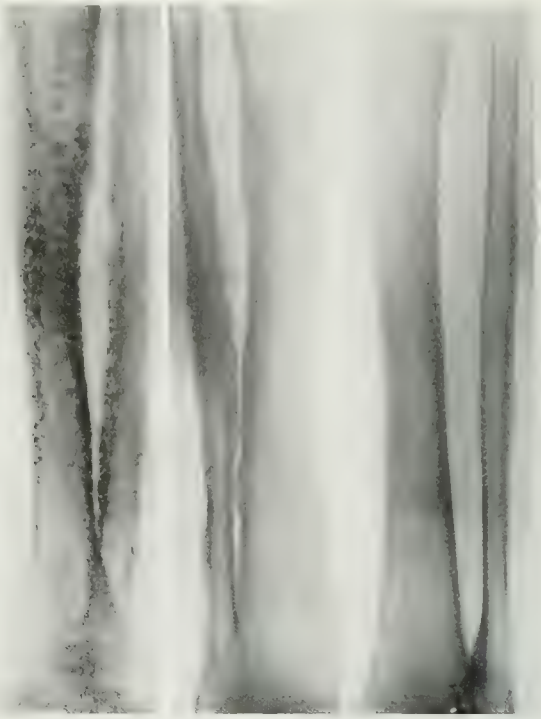


Fig. 5 Fig. 6

Fig. 5. Case 2. Roentgenogram of the right leg showing extensive periosteitis and osteomyelitis of both bones with narrowing and irregularity of marrow cavity. Calcification of vessels has been present but has not been marked.

Fig. 6. Case 2. Roentgenogram of left leg showing slight calcification of vessels. Little or no bone changes.

communicate with the above and lie in close relation to the deep vessels of the leg. Given a chronic lymphangitis of the perivascular lymphatics, and it is easy to see how bacteria migrating through the delicate lymphatic wall soon penetrate the walls of the adjacent artery and vein. This takes place throughout the full extent of the vessel in the leg, and hence the nutrient arteries to the tibia and the fibula may become simultaneously involved. The bacteria may then penetrate the walls of the nutrient vessels and thus be distributed to all parts of the bones, or we may postulate a retrograde lymphatic infection against the normal lymphatic current. Either process seems reasonable and probably both occur. Thus we find an explanation for even the most extensive changes in bone and artery.

During this time the body has manufactured antibodies sufficient to prevent the spread of the infection, but not sufficient to prevent damage to the tissues from the continued presence of bacteria. It is well known that calcification is often a late result of chronic infection. The calcified areas in tuberculous foci, old abscesses, chronic infections of the lymph-nodes, bursæ, and joints, syphilitic aortitis, and thrombophlebitis, as well as concretions, biliary, renal, etc., which have been definitely shown to be originated by bacteria, are only a few of the numerous examples of this process. In view of this it is easy to see how the calcification of the vessels and the structural alterations of the bones would be simply a logical result of the continued absorption of bacteria from a chronic ulcer. Some interesting speculations are, however, aroused by these conclusions: Are more vital structures injured in a like manner? To what extent is arteriosclerosis in general dependent on bacterial absorption, and to what degree is the aging of other tissues influenced by similar processes?

Fig. 7. Case 3. Photograph of leg showing marked varicosities and thrombophlebitis. Over the anterior crural region is a small depressed scar of a healed ulcer. The varicosities have been present 15 years, the ulcer 6 years. The opposite leg shows similar changes but less marked.

Fig. 8 Fig. 9

Fig. 8. Case 3. Roentgenogram of leg shown in Figure 7, showing extensive productive osteitis of both bones with involvement of marrow cavity.

Fig. 9. Case 3. Roentgenogram of opposite leg. The bone changes are much less marked. This corresponds to the lesser severity of thrombophlebitis on this side.

These are problems worthy of further study. It may well be that kidneys, heart, and nervous system are damaged in a like manner by the insidious influence of cryptic infections. The prompt recognition and vigorous eradication of such lesions would then be regarded as essential to the prolongation of life.

The following cases, illustrating the pathological processes outlined above, represent merely a few of the large number studied. In the entire series the changes were the same, differing merely in degree. They were always more marked in the leg showing the worst varicosities or the most prolonged ulceration and were regularly absent in the opposite extremity if this was free from varicose veins. The photographs of the X-ray plates of these cases are of necessity greatly reduced and fail to do justice to the originals in which the osteomyelitis is shown with great clearness.

Case 1. Louisa M., for five years the patient has had ulcer of the posterior crural region of right leg, extending over an irregular area 4 inches in diameter. The margins were irregular. The ulcer was slightly depressed; the floor covered with grayish and greenish slough and unhealthy granulations. At no point is there any sinus penetrating into the deeper structures, and the floor of the ulcer is everywhere firm. There are scattered islands of healthy skin, but the crural region and the dorsum of the foot are somewhat œdematous. There are moderate varicosities of superficial veins, including internal saphenous, above the ulcer. The Wassermann was negative with both antigens. The pulse was very poor in the dorsalis pedis artery. The opposite leg shows moderate varicose veins and brownish pigmentation, but no ulceration is present. Urine: specific gravity 1015;

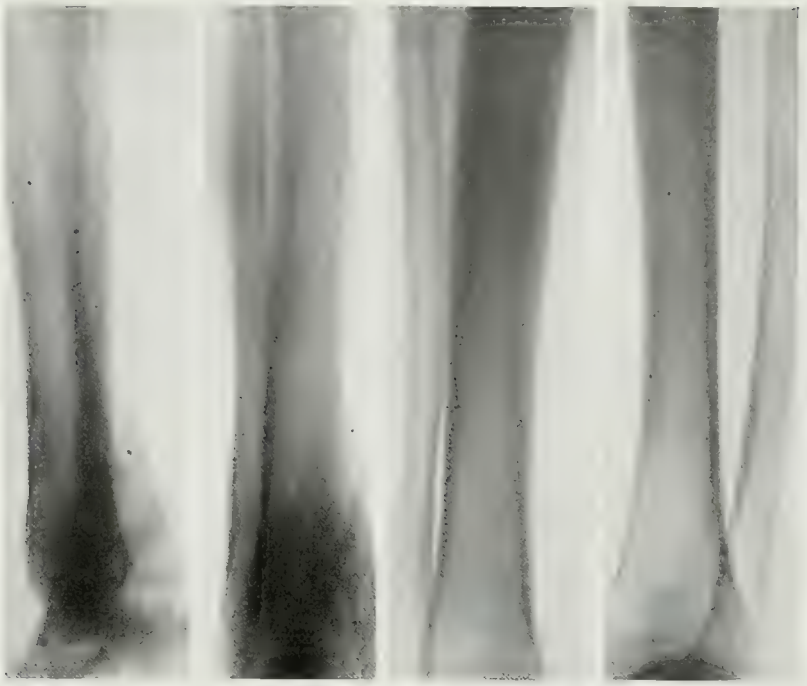


Fig. 10 Fig. 11

Fig. 10. Case 4. Roentgenogram of Figure 10, showing extensive changes in both tibia and fibula. The tibia is greatly thickened, the marrow cavity appears partly obliterated in both bones. There is marked calcification of the vessels which are covered by shadows of the bones.

Fig. 11. Case 4. Roentgenogram of left leg showing absence of marked bone changes. There is extensive calcification of the vessels.

reaction, acid; albumin, faint trace. Microscopic examination shows large numbers of bacteria, discrete and in clumps. There are a few white blood cells and epithelium. The ulcer progressed favorably under local treatment and baking and massage. X-ray examination of right leg (No. 65569) shows marked bony changes throughout fibula and tibia, most marked over lower half of fibula which is greatly thickened and shows nodular periosteal excrescences. The cortex is greatly thickened and the narrow cavity encroached upon. Similar changes are present in the tibia but to a less degree. Marked calcification of posterior tibial vessels of right leg. No similar changes in left. The Wassermann was negative with alcoholic and cholesterin antigens.

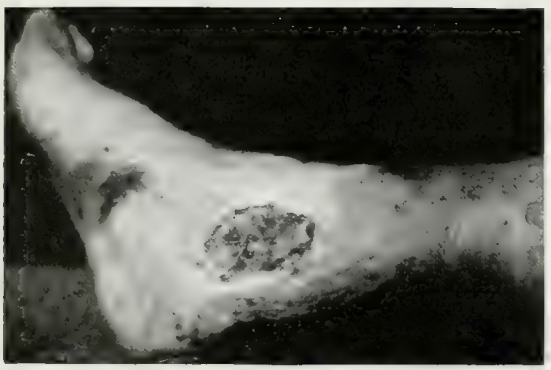


Fig. 12. Case 4. Superficial ulcer of the medial crural region of the right leg which has been present for 25 years. There are marked trophic changes in the skin of the foot. Extensive varicose veins are present. The opposite leg has a pigmented scar of healed ulcer and moderate varicosities. There is no recent ulceration.

Case 2. John F., age 69, plasterer. This patient had ulcers of the anterior crural region, about which there was marked eczema. An ulcer of the right leg had been present at intervals for 20 years, of the left leg for one year.

The right leg was greatly swollen, reddened, and covered with crusts. There was a large irregular ulcer 4 x 2 inches in diameter over the anterior crural region of the right leg. The left leg was reddened and scaly but not ulcerated. There was considerable thickening of both legs. Varicosities of internal saphenous on right side were present.

Fig. 13 Fig. 14

Fig. 13. Case 5. Roentgenogram of Figure 15, showing extensive periosteitis and osteomyelitis of entire fibula. The tibia is involved to a less extent. Calcification of the vessels present.

Fig. 14. Case 5. Roentgenogram of opposite leg showing no bony or vascular changes. There are no varicose veins or ulceration of this leg.

There was a systolic murmur over the aortic area. Urine: specific gravity, 1027; reaction, acid; albumin, very faint trace. Glucose, positive. Microscopic examination showed epithelial cells and a large amount of bacteria. The Wassermann was negative.

Case 3. Henry S. The patient had had varicose veins of both legs for 15 to 20 years. He had had pain in both legs for one year. There was an ulcer of the left anterior crural region six years ago but this is now healed. There was extensive thrombophlebitis of the superficial veins of both legs, especially on the right side. The veins were greatly dilated, containing hard nodules resembling phleboliths. X-ray examination showed extensive periosteitis and osteoyelitis in the bones of the left leg. The Wassermann was negative with both antigens.

Case 4. James O'Brien. An ulcer had been present over the medial crural region of the right leg for 25 years. The ulcer was about 2 inches in diameter, superficial and located just above the internal malleolus. The skin about this was thickened and the papillæ were hypertrophic. The base of the ulcer was pale and grayish. The pulse was poor in dorsalis pedis. The toe-nails showed trophic changes; onychogryphosis; leg and foot were swollen and the ankle stiff. The skin was unhealthy and pigmented. The skin of the opposite leg was thickened and pigmented. Pulse in the

Fig. 15. Case 5. Shallow ulcer of the lateral crural region which has been present for 15 years. There is extensive eczema and elephantiasis of the skin. Varicosities are marked along the distribution of the internal saphenous vein.

Fig. 16. Case 6. Roentgenogram of a leg which has been the site of an ulcer, 2 by 3 inches in diameter, for 20 years. Photograph of leg not available. Extreme periosteitis and osteomyelitis of both bones and calcification of the posterior tibial vessels present. The opposite leg appears normal on X-ray examination.

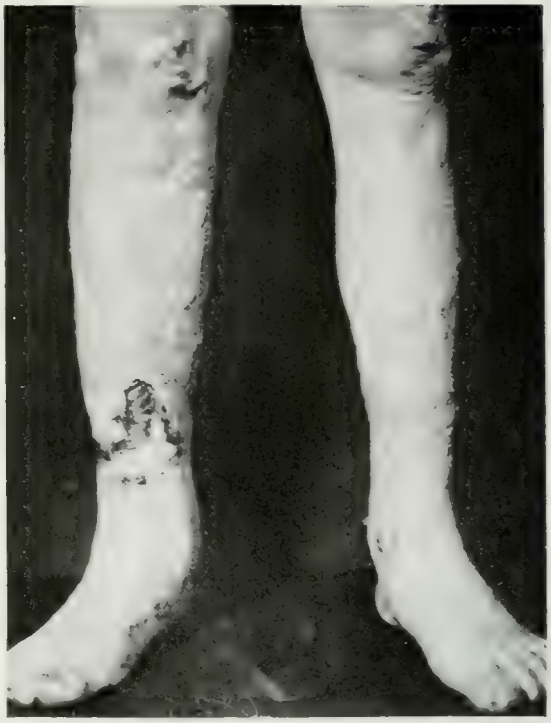


Fig. 17. Case 7. Shallow ulcer of the right anterior crural region which has been present 4 years. There are extensive varicose veins and eczema of both legs.

dorsalis pedis was likewise poor. Urine: albumin very faint trace; few clumps white blood cells. Hypertrophy of prostate. Blood pressure: 210 systolic; 100 diastolic. The Wassermann was negative with both antigens. The ulcer was very sluggish; no progress toward healing has been made in spite of careful and continuous treatment. X-ray examination of right leg showed very marked bony changes in both tibia and fibula. The tibia was thickened throughout, especially in the lower half which resembled a club. There was extensive periosteitis and osteomyelitis. The marrow cavity appeared obliterated by dense bony proliferation. Calcification of posterior tibial vessels was marked. X-ray examination of left leg showed bones normal, and marked calcification of deep vessels.

Case 5. Louis Barteldes, age 55; driver. The patient has had an ulcer of the lateral malleolar region for 15 years. The ulcer was about 1 by 1.5 inches in diameter, superficial and surrounded by thickened hyperplastic skin. The entire leg was thickened and somewhat œdematous over the lower part. The soft parts were thick and tough from the presence of increased fibrous tissue. The bones were palpably thickened. There was little or no pain in the leg, and no disability. The patient has varicose veins of both legs and marked eczema. Blood pressure: systolic, 175. Pulse, 35 to 40 beats to the minute. The cardiac rate was the same. Second aortic sound accentuated. Area of cardiac dullness enlarged. The Wassermann was negative with both antigens.

Case 6. Theresa R., age 63, housework. The patient has had an ulcer of the anterior right crural region for 20 years or more. She has extensive varicose veins. There were no symptoms except pain and swelling of the leg. There was an ulcer over the middle of the tibia, 3 by 2 inches in diameter, with a sinus which passed to the bone. The leg was greatly swollen and œdematous. There was an enlargement of the entire leg apparently due to bony thickening. The opposite leg was normal except for slight varicosities. Temperature, normal. The Wassermann was negative with both antigens.

Case 7. Joseph F., age 60, carpenter. The patient has had varicose veins and ulcers of both legs for four years, with extensive varicose veins of both legs and ulcers over both shins, largest on right leg. He had extensive eczema. X-ray

Fig. 18. At left, roentgenogram of right leg showing extensive osteitis and calcification of vessels. At right, roentgenogram of left leg showing bony changes less marked. There is no calcification of the vessels.

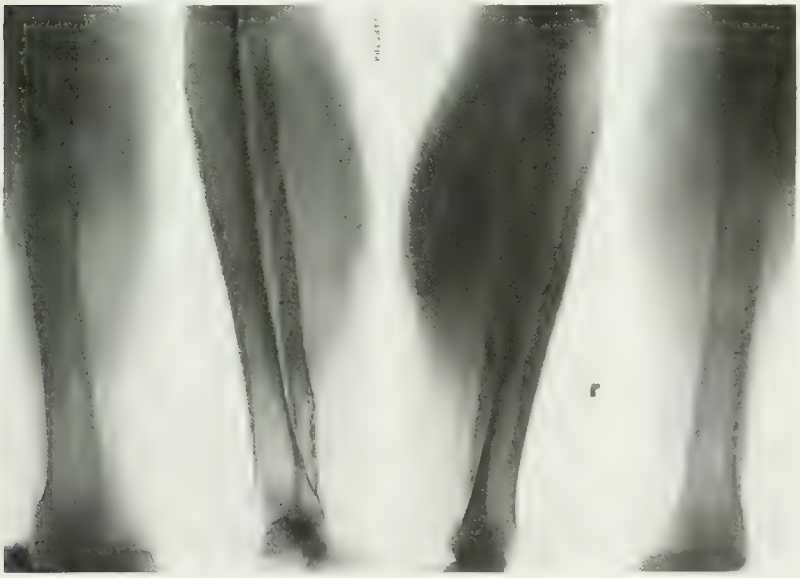


Fig. 19. Case 9. At left, roentgenogram of both bones of the right leg, showing irregular periosteitis and calcification of vessels. At right, roentgenogram of left leg, practically normal.

Fig. 20. Case 8. Varicose veins of the right anterior crural region which had been present for 17 years. At left, roentgenogram of the right leg showing marked bony changes in the fibula and the upper half of the tibia. There is pronounced vascular infiltration. At right, roentgenogram of left leg practically normal.

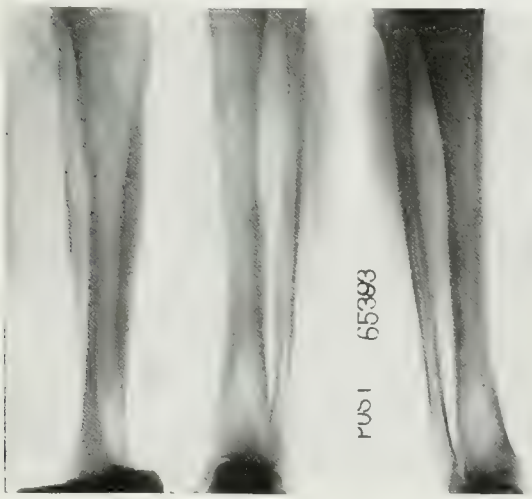


Fig. 21. Case 10. At left, roentgenogram of both bones of left leg showing diffuse osteitis. At right, roentgenogram of right leg showing slight periostitis of fibula.

Fig. 22. Case 11. Varicose veins of both legs for many years. There is an ulcer of the left anterior crural region which has been present for 3 years. Roentgenogram of both legs showing moderate osteitis of fibula in each.

examination showed extensive periosteitis and osteomyelitis involving the interosseous space, especially in the right leg. Calcified blood vessels were clearly shown. The Wassermann was negative.

Case 8. Amelia H., age 53, housewife. The patient has had an ulcer of the anterior crural region of the right leg for 17 years. On the anterior aspect of the right leg at the junction of the middle and lower one-third was an irregular superficial ulcer 3 by 2 inches in diameter. Varicose veins of both legs were present but not marked. There were localized areas of thrombophlebitis. The leg was swollen and somewhat œdematous. The ankle was thickened and the soft parts dense and boggy. The Wassermann was negative. Urine: specific gravity, 1,030; reaction, acid; albumin, trace glucose, 3+ Microscopic examination; showed mucous leucocytes and squamous epithelium. Blood pressure: 170 to 110. Heart: no murmurs, no enlargement. X-ray examination of the right leg showed characteristic bone and vascular changes. None in left.

Case 9. Margaret M. The patient had had an ulcer of the anterior crural region of the right leg at intervals for over 20 years. At times the ulcer healed, but soon broke down again on slight trauma. Varicose veins were present. The Wassermann was negative. There is an ulcer at present about 3.5

Fig. 23 Fig. 24

Fig. 23. Case 12. Roentgenogram of left leg showing slight periosteitis of fibula and calcification of vessels. Roentgenogram of right leg normal.

Fig. 24. Case 13. Roentgenogram of left leg showing moderate osteitis of both bones. Calcification of vessels present. The opposite leg appears normal on X-ray examination.

inches in diameter; superficial. The base of the ulcer is covered with unhealthy granulation. There is œdema of the right leg. A culture from the ulcer shows bacillus mucosus capsulatus, and staphylococcus albus. Urine: there is a trace of albumin; otherwise negative. X-ray examination showed moderate periosteal thickening and roughening in the right fibula, most marked in the lower half of the bone. Also there was slight periosteitis in the right tibia. No similar changes were present in the left. The posterior tibial vessels of the right leg were partially calcified. No similar changes in left.

Case 10. Richard S. The patient has had an ulcer of the anterior crural region of the left leg for 10 months following trauma. The patient struck his shin with a barrel hoop and several ulcers appeared, of which one failed to heal. This was about 1 inch in diameter and was located over the anterior border of the tibia. There were moderate varicosities of both legs, especially marked in the left leg. The skin of the right leg was slightly œdematous and pigmented. The Wassermann was negative. The ulcer healed under appropriate treatment. X-ray examination of the left leg showed thickening and roughening of the periosteum of both bones, diffuse throughout the entire shaft. There was no indication of osteomyelitis. Calcification of vessels. X-ray examination of the right leg showed similar changes but

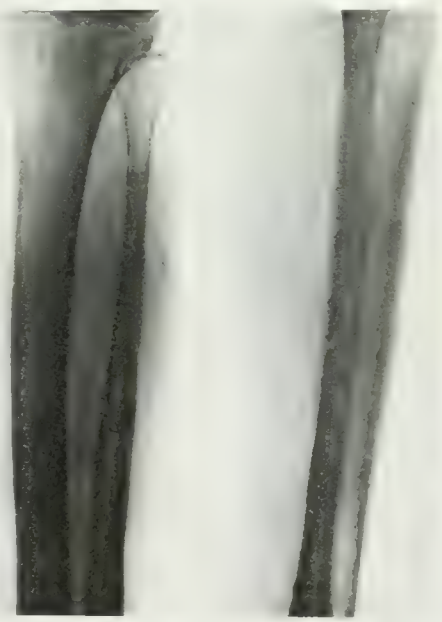


Fig. 25. Case 14. Roentgenogram of left leg showing osteitis of fibula and calcification of vessels. The right leg appears normal on X-ray examination.

less marked in the bones of the right leg. There was no calcification of vessels.

CASE 11. Emma M., age 40, housewife. The patient has had varicose veins of both legs for years. She has had a superficial ulcer of the left anterior crural region for three years. The Wassermann was negative.

CASE 12. Louis M., age 57, expressman. The patient had a varicose ulcer of the left anterior crural region which had been present for 8 years. The ulcer healed at intervals but returned 7 months ago, since which time it has been growing steadily larger. The patient has an extensive ulcer over the anterior and medial crural region of left leg, 6. 5 inches long, and 5 inches wide. The ulcer was superficial. Marked varicose veins were present. The Wassermann was negative. The ulcer healed in six weeks under treatment. The right leg was normal.

CASE 13. Henry G. The patient has had varicose veins of both legs for many years. The left leg showed a pigmented scar of healed ulcer. There was chronic intermittent ulceration about the left great toe-nail associated with onychogryphosis. X-ray examination showed moderate osteitis of the bones of the left leg and marked calcification of vessels. The right leg was normal. The Wassermann was negative.

CASE 14. Anna B., age 56, cook. The patient has had varicose veins of left leg for many years. One year ago an ulcer on the anterior crural region healed after several weeks' treatment. The present ulcers have existed for three weeks. Patient has two ulcers on the left anterior crural region, one about 2 inches above internal malleolus 2 inches in diameter; the other about opposite middle of anterior border of the tibia, 1 centimeter in diameter. Both are superficial and do not extend into the subcutaneous tissue. The Wassermann was negative.

RECURRENT INTERNAL HERNIA FOLLOWING GASTRO-ENTEROSTOMY

BY ROBERT C. BRYAN, M.D., F.A.C.S., RICHMOND, VIRGINIA

MOSCHCOWITZ and Wilensky[1] recognize the possibility of internal herniation with gastro-enterostomy and to prevent such a hernia between the upper loop state that it is well to suture the afferent loop of the jejunum to the lower surface of the transverse mesocolon with about four interrupted sutures.

Herbert J. Patterson, in *Surgery of the Stomach*, 1914, further recognizes the possibility of this complication and states that:

Several instances of internal hernia after gastro-jejunostomy have been recorded. In most of them a portion of the small intestine has slipped through the artificial aperture in the mesocolon and has become strangulated. So far as I am aware, since the adoption of the practice of suturing the edges of the mesocolon to the jejunum or stomach, no instance of this complication has been recorded.

B. A. G. Moynihan gives the following specific cases in his *Duodenal Ulcer*, second edition, 1912:

CASE 16. Death occurred on the tenth day with symptoms pointing to intestinal obstruction. At the autopsy it was found that almost the whole of the small intestine had passed into the lesser sac through the opening made in the transverse mesocolon for the performance of the anastomosis. A similar hernia occurred in Case 24; this was more gradual in onset, but necessitated operation at a later date. Since that time it has been a routine procedure to suture the margin of the opening in the mesocolon to the line of the anastomosis in order to prevent such an accident.

F. D. M., mechanic, referred by Dr. J. F. Jones, of Richmond, Va., was brought to Grace Hospital January 9, 1918, having experienced an agonizing pain in the pit of the stomach while at work.

Upon examination the abdomen was found board-hard and diagnosis of perforated gastric or duodenal ulcer was made. Under general (ether) anæsthesia a high median incision showed a round, small, perforated ulcer of the anterior wall of the first part of the duodenum through which fluid and bubbles of gas were escaping. There was considerable fluid and flakes of lymph in the abdominal cavity; there were no adhesions about the ulcer and the area of induration extended about one inch from the perforation in every direction. The hole was pared, purse-string invaginated, sewn over, and a small tab of omentum from the gastrohepatic omentum was tacked about the hole. The wound was brought together with catgut No. 2 in layers, with silkworm gut through the skin. A stab opening was then made below the appendix and a rubber tube inserted into the pelvic cavity for drainage. The tube was removed from the stab wound in

[1] Surg., Gynec. & Obst., 1915, xxxi, 390.

Fig. 1. Hernia of the jejunum posterior to the gastrojejunostomy. At operation the intestines were simply pulled back.

three days, the patient had an uneventful convalescence and was able to leave the hospital in four weeks, eating solid food and declaring he felt in excellent health.

About a week after he left the hospital he returned stating he had acid eructations and some discomfort and pain in the stomach. The operation of gastro-enterostomy was explained to him, he decided to have it done and he was operated on at The Sheltering Arms Hospital, March 5, 1918. Under general (ether) anæsthesia and with high median incision the usual posterior gastrojejunostomy was performed. It was interesting to note that the duodenal perforation had healed well, and whitish radiations were seen under the omental tab which had been tacked at the opening, the abdominal wall being brought together in layers with catgut No. 2 and the skin with silkworm gut. The original stab wound was opened up as a gridiron, and a long chronically inflamed appendix was removed by severance and purse-string invagination. The patient had an uneventful course for 10 days, to March 15, when he suddenly developed vomiting of a stercoraceous character, which was followed March 17, by the vomiting of blood. He was now much shocked, with subnormal temperature and pulse 150. The diagnosis of hæmorrhage from the original perforation or about the gastrojejunal junction was made, and, although the patient was much weakened by his lack of nutrition and incessant vomiting, for the third time the wound was opened up (ether anæsthesia) in the same line (high median) and it was found that the small intestines had gone through behind the jejunogastric hiatus, were hanging to the left over the junction of the jejunum with the stomach, so that there was a constriction of the smaller intestines with enormous distention of the duodenum and jejunum as far as this point; the mesenteric vessels were engorged and the walls of this segment of the gut blue-gray, with small dark petechial hæmorrhages here and there. The intestines were pulled back through the opening, replaced in their right position, the peritoneum soon gaining its normal color. The contents of the jejunal loop were stroked onward. There was no evidence of inflammation about the original perforation or about the new hiatus. The appendix scar from within was clean, with no adhesions. The wound was brought together with catgut No. 2 in layers, silkworm gut through the skin. The patient returned to bed in a rather weakened state and distinctly shocked. Murphy's solution, drop method, and hypodermoclysis were instituted, and in two days his condition was again satis-

Fig. 2. Jejunojejunostomy carried out and the descending loop sewn to the abdominal peritoneum to prevent a recurrence of the hernia.

factory. Fluids and nourishment were now being given by mouth. The night of the 22d he developed again a constant and continuous regurgitant vomiting, complaining of pain in the pit of the stomach. Diagnosis: Recurring gastrojejunal hernia. On March 23, under general (ether) anæsthesia the wound was for the fourth time opened through the same high median incision by cutting the stitches and tearing through the belly wall with the finger. The intestines were found to have again gone through the same opening, there was intense constriction of the mesenteric blood vessels, large black venous hæmorrhagic spots were seen in the mesentery above the point of constriction, and here and there inflammatory areas of lymph exudate on the peritoneal coat of the intestines, so that the intestines were stuck together with many angulations. The intestines were again pulled back through the opening and replaced in their normal bed, and, to prevent a recurrence, the small intestines were sewn by several stitches of silk to the right lateral abdominal wall and an enterojejunostomy was performed so that the contents of the now much distended and apparently paralyzed jejunal loop could pour into the intestines beyond. Hypodermoclysis was carried out while the patient was on the operating table. The patient's condition continued extremely critical for several days, during which time Murphy's drop method was intermittently instituted. There was some regurgitation-vomiting following the fourth operation. All nourishment was administered by the rectum only for three days.

Fig. 3. Schematic illustrations showing direction of flow of intestinal contents.

The patient rapidly began to pick up, but developed a large bed sore over the sacrum and complained constantly of heartburn requiring alkalinization.

Fig. 4. F. J. M. Roentgenogram. Dr. F. M. Hodges, Richmond, November 8, 1919, twenty-one months after operation. *A*, Gastro-enterostomy; *B*, jejunojejunostomy

April 10. Patient has been on solid food for a week, is sitting up in a chair, is gaining rapidly, there is no waterbrash, there is no pain, the bowels are working well. He declares he feels better than he has for the past year.

February, 1919, the patient has been at work for several months, weighs 190 pounds, the digestion is excellent, there is no pain or discomfort, and on coughing and straining there is apparently no weakening of the high "median line of multiple incisions."

COLLOID ADENOCARCINOMA OF THE BLADDER[1]

By B. S. BARRINGER, M. D., New York
Surgeon to the Memorial Hospital

THE following case of colloid carcinoma of the bladder is unique, as far as a brief search of the literature reveals. Both Dr. Ewing and I have been unable to find the report of any tumor that resembles it.

A man of 44 years was first seen in June, 1918. He gave the history of having suffered pain in the left inguinal region for 4 years, and had noticed a growth in his lower abdomen for 2 years. This had been slowly growing larger. There was no marked frequency of urination, and no history of hæmaturia. He was a strong man and had worked up to the present time.

On physical examination I found a regular, firm suprapubic tumor extending to within 2 inches of the umbilicus. The tumor was flat to percussion, and not fixed. It could be felt per rectum. The prostate was slightly enlarged and smooth. Cystoscopy showed a tumor as large as a small orange pressing in the top of the bladder, covered with normal mucous membrane except at one spot where the mucous membrane was thrown into folds and reddened.

Because we did not know the nature of this tumor and because of the marked susceptibility of some tumors to the "radium pack," a pack of 1131 millicuries for 16 hours (18,096 millicurie hours) was placed over the suprapubic mass and the growth watched for the following three months. Radium used in this way is heavily screened with lead and wood and placed some inches away from the skin. This method of radiation is quite different from that usually used, e.g., in carcinoma of the bladder where the radium is placed directly upon the tumor.

There were two practical reasons for treating the tumor with radium. First, by its use the tumor might be reduced in size and so be made more easily operable; and second, if operation were necessary the effect of the radium might be to reduce the malignancy of the tumor cells and so reduce the chance of implantation of active tumor cells at the time of operation. This sounds perhaps chimerical, but it is, I believe, a decidedly practical consideration. For instance, in teratoma of the testicle, if the growth has gone beyond the testicle, our present viewpoint is that radium in the form of a radium pack is quite as, if not more, important than operation. In this case, however, the radium apparently had no effect. During the three months the tumor grew slightly larger. I then operated upon him, and found a very large tumor, growing from the bladder, but attached to no other abdominal organ.

It was manifestly malignant with soft gelatinous spots surrounded by harder fibrous areas. The tumor was cut off from the bladder, the lower half of which was left apparently tumor free. This was sutured up tight with a double row of plain catgut sutures and the abdominal wall was sutured, a small drain being left going down to the bladder. A retained catheter was put into the urethra. This the patient passed out the night following operation. He has urinated without trouble by urethra ever since. Three months later I saw by cystoscopy some irregular tumors around the bladder neck which I took to be implantations. The top of the bladder showed no tumor and not even the scar of the incision. The bladder neck was treated by a strong dose of radium. I saw him last in May, of this year, 8 months after his operation. He had a slight radium burn of the bladder neck, slightly increased frequency of urination, and no tumor that could be seen or felt. He has been working for 6 months. Dr. Ewing's pathological report was:

"Tumor of bladder, teratoid tumor.

"The tumor is a nearly spherical mass, 11 by 18 by 7½ centimeters. It is said to have been within the wall of the bladder, lying on the upper and posterior surface, leaving the mucosa free while adherent to the peritoneum which covers a considerable portion of the surface. The surface presents numerous soft protruding cystic nodules, which also compose most of the mass of the growth. On section the tumor is composed of a central core of dense fibrous tissue radiating out to periphery and inclosing cysts of various sizes filled with firm gelatinous material. This material becomes more abundant toward the periphery. There is a peculiar slit-like opening in the central core.

"Microscopic sections show the structure of a cystic adenocarcinoma with advanced gelatinous degeneration which has destroyed most of the tumor cells. The stroma is of dense hyaline acellular fibromuscular tissue, in which there are numerous calcific foci. The general appearance is that of the intestinal gelatinous carcinomata, but the cells are flat or cuboidal, and not cylindrical.

"The tumor probably belongs to the group of teratoid tumors of the bladder, but its exact origin is not clear. Possibly it arises from a misplaced remnant of embryonal intestinal canal."

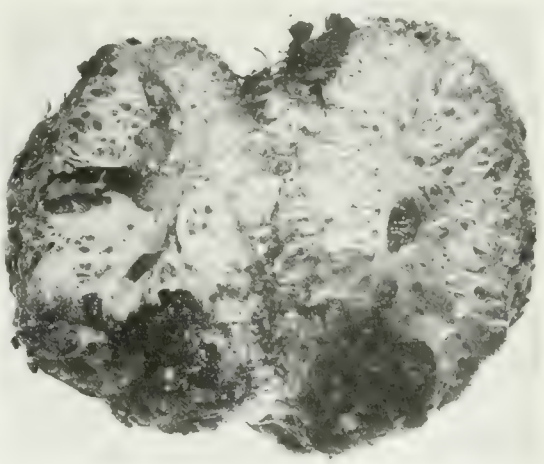
My thanks are also due to Dr. Ewing for the following comments on the tumor:

"I do not find any compelling reason for assuming an origin from remnants of allantois or cloaca in the cases of mucoid carcinoma of the bladder reported by Chute and Crosbie and by Mandelbaum, or in the cases cited by them from the literature. I have looked up the original reports of these cases and find that all the tumors were located in and often confined

[1]From the service of the Memorial Hospital

chiefly to the vesical mucosa. The development of mucous carcinoma from the epithelium of the vesical mucosa, either on the basis of cystitis cystica in which the follicles regularly produce mucus, or from the mucous glands of the trigone, has been fully traced by Stoerk. There is no doubt that mucous carcinoma of the bladder occasionally arises in this way as does the usual type of carcinoma without mucous changes. In Haake's case there were extensive mucous changes in a polyoid tumor attached to the mucosa by a long pedicle.

"Your case, however, appears to be quite different from all the cases cited above in that it was chiefly extravesicular, being merely attached to the wall of the bladder and invading it only slightly, and unaccompanied by any broad invasion of involvement of the mucosa. For such a tumor it seems necessary to assume an origin entirely apart from the structures of the mucosa, and remnants of the allantois or cloaca present themselves as possible sources. Since your tumor lay near the apex of the bladder and since the allantoic duct as Piersol points out forms the upper part of the bladder, the allantoic duct seems the most probable origin. I have been unable to find any reference to tumors of the adult rising from allantoic epithelium, and know nothing about the probable structure of such tumors if they exist. Your tumor has a very peculiar gross structure. It presented a hard fibrous core about 3 to 4 centimeters wide in which were slits and crevices containing only mucus, while surrounding this core on all sides were more recent and more cellular portions containing alveoli of adenocarcinoma and growing cells with much mucus in alveoli and stroma. Such a gross



Colloid adenocarcinoma of the bladder. The tumor has been split open.

structure could hardly have been produced from any tissues originally within the bladder mucosa. Therefore, an origin from some extravesicular tissue rest appears highly probable, and the allantoid ducts seems to be the most natural source of such a tissue rest. This origin can only be regarded as an assumption.

"I have been unable to find any tumor like yours in the literature of bladder growths, but there is a series of very firm gelatinous carcinomata of the pelvis to which your case may belong."

DEPARTMENT OF TECHNIQUE

THE TECHNIQUE OF INGUINAL HERNIOTOMY

With Special Reference to the Closure of the Internal Ring[1]

By E. P. QUAIN, M.D., F.A.C.S., Bismarck, North Dakota
Formerly Lieutenant Colonel, M.C., U.S.A.

THE object of this paper is to call attention to a few anatomic and technical points which are of special importance in our efforts to obtain one hundred per cent permanent cures through the radical operation for indirect inguinal hernia. Although the technique which will be described, and the reasons for its adoption, cannot be claimed to be original except in some of the details, the ensemble of the proceedings is unquestionably of quite recent origin.

During my service in the army in the past year and a half I have had the opportunity of having under surgical treatment and observation several hundred cases of indirect inguinal hernia. In the spring months of 1918 at the cantonment hospital, where I was then on duty, our daily list of herniotomies varied between 10 and 25. It was, therefore, natural that this subject required and was given somewhat intensive attention in our surgical service. As a result of our studies and experiences we arrived at rather definite conclusions as to the technique most likely to offer permanency of cure. Most of the hernias had not been subjected to previous operation and gave us therefore the primary opportunity of offering a cure through operation. But there were presented to us a fair number of cases in which recurrence had taken place after one or more earlier operations. These were of special interest because they gave us the opportunity of trying to find out why recurrence had taken place.

Associated with me in the service were a number of surgeons, some of greater and some of lesser experience in the treatment of hernia. Discussions with these surgeons, and the opportunity of familiarizing myself both with their previous results and with their actual steps of technique helped to throw light on the subject. Without going further into detail it may be stated that there were found to be four general causes for failure in operation: (1) leaving the stump of the sac too long; (2) failure to close properly the internal abdominal ring; (3) leaving too much unnecessary tissue attached to the cord within the internal ring; (4) letting the patient resume work too early after operation for large hernia.

It is assumed that all those who attempt any hernia operation as a procedure of choice, are already familiar with the anatomy of the structures involved. The only structure requiring review for the present purpose is that of the spermatic cord. The spermatic cord is composed of several elements. Among these, the vas deferens and the spermatic artery and veins, all passing through the internal abdominal ring, are the most important. A continuation of the transversalis fascia lies in front of the vas and vessels and becomes a sheath for both just outside the ring. A loose areolar tissue with fat appears under the transversalis fibers. The cremaster muscle forms a covering over the cord, but is, from a surgical point of view, an element of the cord. The ilio-inguinal nerve passes obliquely over the cremaster, and the genital branch of the genitocrural nerve escapes through the internal abdominal ring. When an indirect hernia exists there is in addition the hernial sac incorporated with the cord and within the prolongated transversalis fascia.

The cremaster muscle has its origin from the outer part of Poupart's ligament, including that sector of this ligament which lies nearest the internal ring. This is the first of the cord elements which must be identified and properly disposed of in the operation, after the inguinal canal has been laid open. The fibers attached opposite the internal ring should be loosened from Poupart's ligament so as to allow close contact between the lower margin of the internal oblique muscle and Poupart's ligament in the closure of the ring later on. If the cremaster is very heavy it will cause the cord to remain too

[1] Read at North Dakota State Medical Association, Grand Forks, June 25 1919

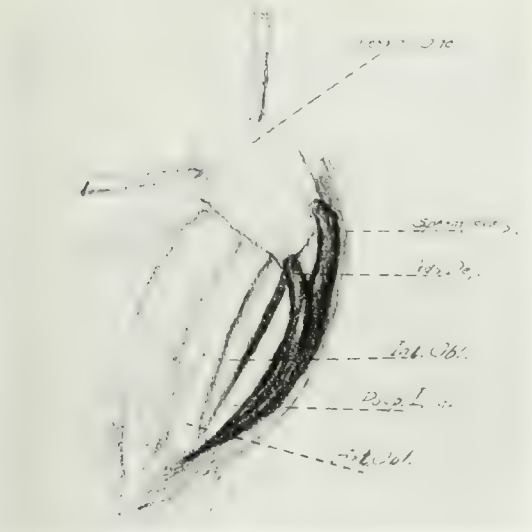


Fig. 1. Showing the "triangle" formed by vas deferens, spermatic vessels and base of hernial sac.

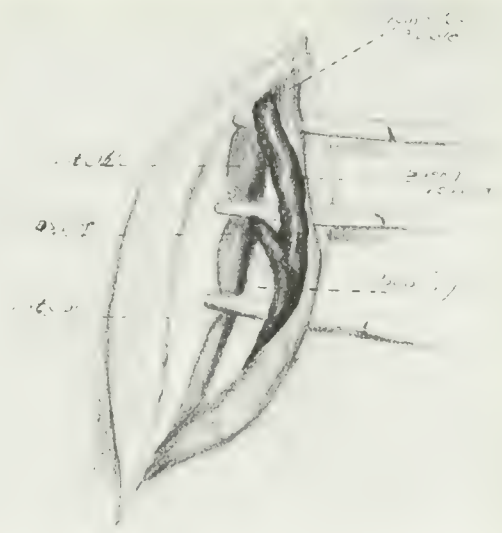


Fig. 2. Two forceps placed between vas deferens and spermatic vessels and clamped to margin of external oblique aponeurosis. A third forceps clamped below vas.

voluminous and to occupy too much space under the fascia of the external oblique at the completion of the operation. In that case a part or all of the cremaster fibers should be cut across as near their origin on Poupart's ligament as possible. The cut ends of the fibers, assembled and held by a forceps, should be lifted and dissected loose from the rest of the cord. The forceps holding the muscle are laid aside until the closure of the external oblique is completed. Then the forceps with the cremaster is pulled up over the external oblique aponeurosis where the muscle is sutured into place in such a way that a slight lifting action is seen to be exerted on the structures of the scrotum.

After the cremaster had been disposed of, the hernial sac is identified and dissected free. At its base it will be found to lie above and between the vas deferens and the spermatic artery. When the sac is markedly adherent, or prolonged along the cord, no time should be wasted in trying to find its apex by dissection outside the sac. It is better to open the sac at once, insert a finger and dissect it free while the finger is used as a tractor. A better hold on the slippery peritoneum is obtained by winding a layer or two of gauze over the finger. Hernial contents, if present, are replaced, and the base of the sac is loosened in its entire circumference. It is the writer's opinion that if there is any one step of more importance than other steps in a herniotomy, it is the thoroughness of liberating the sac from its surrounding structures *within* the internal abdominal ring. In the first place, thorough and high freeing of the sac alone will permit the stump to retract into the abdomen and, secondly, when the sac is radically liberated, the margin of the internal ring also will have been freed from all the fibrous and areolar tissue which otherwise will interfere with proper closure of the ring.

In most old hernias there is found a scar-like area or constriction on the peritoneum within the sac. This fibrous area is adherent firmly to the neighboring parts of the cord. If this constriction should be considered the true neck of the sac and ligation made at this point, the hernia is not likely to be cured. Further examination will reveal the fact that there is a segment of sac extending from the white scar up to the niveau of the abdominal peritoneum, which segment may be from one-fourth to one full inch in length. This is not all. This fibrous area is firmly bound to the cord *outside* the internal ring, and it cannot therefore retract to a point high enough to permit the internal oblique to contact properly with Poupart's ligament in the closure of the internal ring. A stump of the hernial sac remains within the internal ring. The hernia is not cured, it is merely abbreviated. A wedge of peritoneum extends through the abdominal wall at the conclusion of the operation.

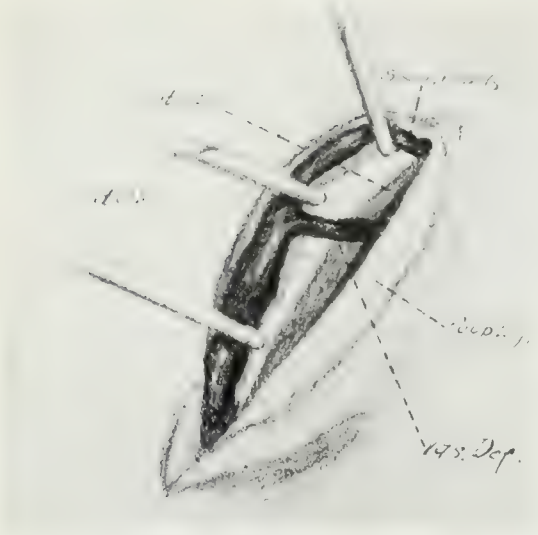


Fig. 3. The three forceps held up to expose internal oblique and conjoined tendon for suturing.

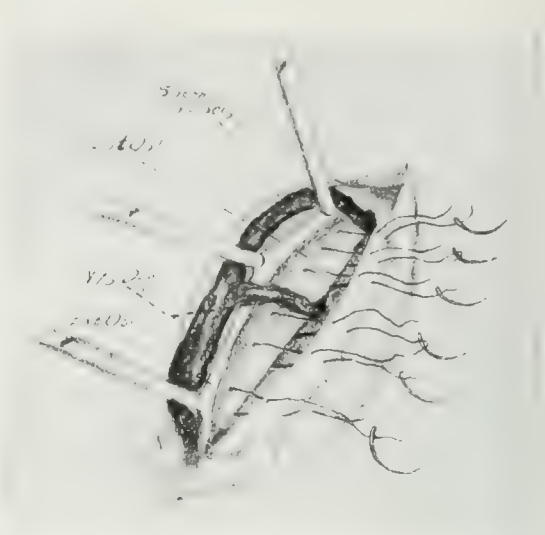


Fig. 4. Three sutures placed between vas and vessels, and three into conjoined tendon below vas.

Faulty suturing of muscle to Poupart's ligament acts as an additional invitation for a subsequent increase of this peritoneal pouch. It is improper to term reappearing pain and bulging in the inguinal canal, after this sort of technique, a *recurrence*. It is a *persistence* of the original hernia.

When the sac is properly liberated from the internal oblique above and from the vas and spermatic vessels below, and traction is made on the sac upward, it will be seen that the vas comes out at the inner or mesial border of the opening and the vessels at the outer margin. It is seen further that the vas comes in an upward direction from the region of the pelvis while the blood vessels come from above. A triangle is formed by the peritoneum above, the vas mesially and the blood vessels externally (Fig. 1). The dissection and preparation of the sac should not be considered completed until this triangle is clearly identified and seen. While traction is exerted on the peritoneal tube, transfixion and ligation are made at the highest point possible to reach with needle and suture. If the sac is broad a puckering suture is needed. After the sac is cut away, the stump retracts promptly and disappears through the opening.

The vas and the spermatic vessels are but loosely connected in the internal ring. They approach one another and become more firmly associated about one-half inch outside the ring. If the hernial opening, i.e., the internal ring, is so large that the index finger can be thrust readily through it, or larger, then the tight closure of the ring is made more certain if the vas is separated entirely from the spermatic vessels and the sutures passed between them. The larger the opening, the stronger is the indication for this procedure. It is necessary always to leave enough opening to permit the two structures to escape from the abdomen. By allowing the vas to come out at one place and the vessels at another, this necessary opening is divided into two openings, each of which need be only half as large as if the two openings were one. This reduces the remaining weakness in the entire technique of herniotomy, practically by half, for the probability of recurrence is in direct proportion to the size of the remaining opening. When vas and vessels are separated from each other and separated from all unnecessary fat and fibrous tissue, they each require a very small opening, say about one-eighth of an inch in diameter. There is in reality but slight disturbance made to either vas or vessels in this technique for the hernial sac and contents have already pushed these structures away from one another, so that the vas remains close to the deep epigastric artery on the inner side, and the spermatic vessels close against the junction of internal oblique and Poupart's ligament on the outer side of the internal ring.

Two artery forceps are pushed between vas and vessels and clamped over the margin of the external oblique aponeurosis, so as to hold the two structures separated and out of the way for the placing of the sutures. Another forceps is

Fig. 5. Showing closure of inguinal canal. Forceps used to hold cord in proper position while internal ring is being closed.

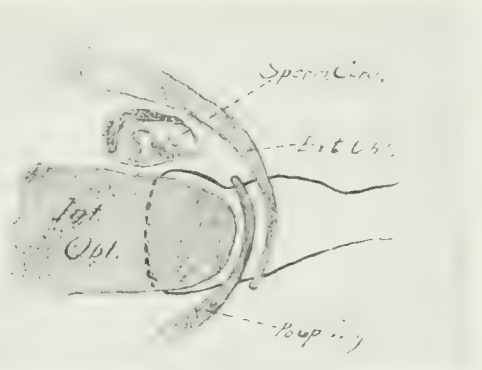


Fig. 6. Cross section of inguinal canal to show approximation of internal oblique to Poupart's ligament and overlapping of external oblique.

placed similarly under the cord, below the vas (Figs. 2 and 3).

When the dissection described is completed properly, it will be found that the lower margin of the internal oblique at this point presents a broad fleshy surface. The transversalis muscle lying under the internal oblique increases the muscular surface now ready to be sutured to Poupart's ligament. No tissue must remain between the muscles and Poupart's ligament. The approximation must be direct and firm, but without undue tension. Three or four interrupted chromic catgut sutures are placed between vas and vessels (Fig. 4). In a large opening a greater number will be required. The sutures are introduced from outside and near the margin of Poupart's ligament. The full thickness of the muscles (internal oblique and transversalis) is included in the suture taken from without inward, but the width of the bite need not exceed one-third of an inch. The needle is repassed through Poupart's ligament well toward its lower margin. Care must be exercised that the sutures are placed at points directly opposing one another on the two surfaces about to be united. When the catgut is tied outside the ligament the internal oblique will thus have the most even and the broadest application possible to Poupart's ligament (Figs. 5 and 6). The internal ring is closed. In a similar manner two or three additional sutures are placed below the vas to approximate the conjoined tendon to Poupart's ligament. No tissue should intervene between these structures, if uniform and permanent adhesions are to be expected. The loose tissues overlying the margin of the conjoined tendon must be cleaned away until this aponeurosis is bare. The uppermost suture below the vas should be placed high enough so that the vas is held somewhat firmly against Poupart's ligament. Owing to the great rigidity of the vas, there is but slight danger of harmful impingement upon it or upon its accompanying artery, by the elastic muscle fibers. The spermatic vessels are also packed into a very small compartment by the stitch nearest them, but more regard must be given to possible constriction of veins here than in the case of the opening for the vas. The spermatic vessels will rest in a muscular foramen of considerable length and the re-formation of an internal ring at this point is scarcely within the range of possibility, after proper healing.

This method of closing the internal ring in a painstaking and accurate manner places a firm and lasting barrier at the very point where the indirect inguinal hernia always begins its protrusion through the abdominal wall; namely, between the vas deferens and the spermatic artery. The method was first described by Dr. Torek[1] of New York seven years ago. Herniæ in which the internal ring is narrower than the size roughly indicated above, do not require a separation of vas and vessels provided the other steps of radical preparation of anatomic structures have been followed out.

The sutures should all be placed before tying any of them. Tying should begin above and proceed to the one nearest the pubes. The catgut is usually tied outside Poupart's ligament, but not

[1] Med. Rec. 1912, June 22.

cut. The ends are rethreaded on needles which are made to pass through the margin of the external oblique aponeurosis above, after removing the three forceps which have held the cord out of the way up to this time. A second tying over this margin completes the closure of the inguinal canal. A smoother closure is obtained if the catgut is not tied at all until after the ends have been passed through the external aponeurosis so as to cause it to lap over Poupart's ligament with one single tying, but this method is a little more difficult of execution, and requires more assistance.

Using the same suture for the double closure reduces to a minimum the amount of catgut to be absorbed. Also, any possible oozing of blood or lymph in the depth of the wound finds a ready route for drainage along the catgut, into the deep superficial tissues where it is more easily absorbed.

Work requiring severe muscular exertion should not be undertaken for several months after a large hernia. Every patient should be taught that his groin will remain "weak" for two to four months after a herniotomy.

Clean dissection, careful control of all bleeding, gentle handling of tissues, and asepsis, are essentials if hundred per cent cure be the standard.

AN IMPROVED WIRE SPLINT FOR CONGENITAL CLUB-FEET

By A. J. DALTON, M.D., St. Joseph, Illinois

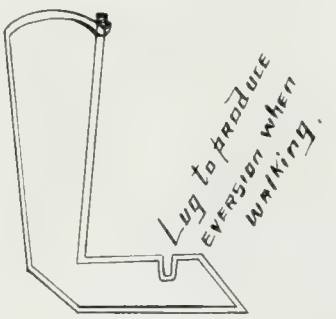
IN 1915[1] I presented a wire splint for the correction of congenital talipes equinovarus. This splint was especially applicable to children before the walking period. Herewith I am presenting a similar splint with the addition of a lug on the inner and anterior border of the foot piece of the splint by which the foot is everted and flexed whenever the child bears weight upon the foot; hence this splint is applicable to the walking period.

In my previous article I stated that the plantar part of the splint could and should be bent to a degree to overcome the equinus and also the varus, this change in angle being made gradually, which will minimize the amount of pain experienced by the child. This change in angle can be made when the splint is taken off at the different dressing periods and these periods usually extend over two or three weeks. Unless the skin is thoroughly bathed in alcohol at this time, there is likely to be some irritation from the adhesive.

In strapping on this splint the strap which holds the heel in place should be an inch to an inch and a half in width and extend up just above the calf of the leg. The foot of the child must be strapped firmly to the foot of the splint before pulling the leg portion of the splint in position, being careful to avoid constriction.

This splint has been so satisfactory in my hands during the past four years, having so many advantages over the plaster cast treatment that I wish to emphasize that, in cases where the deformity has not been of too long standing, all deformity can be overcorrected and maintained until the weakened tendons regain their normal tonicity without injury to the skin or any of the unpleasant results experienced with casts.

[1] Surg., Gynec. & Obst., 1915, xx, 233.



This improvement is applicable in cases walking.

METHYLENE BLUE IN THE DIAGNOSIS OF ACUTE PERFORATING GASTRIC AND DUODENAL ULCERS

By HILLIER L. BAKER, M.D., Chicago

FOLLOWING the preliminary report[1] of the use of methylene blue in the diagnosis of acute perforating gastric and duodenal ulcers, it has been possible to make further observations, and the expectations arising from the use of that stain in perforation have been justified.

The clinical diagnosis of perforation because of the variability of the symptoms is often difficult and at times an exact diagnosis is impossible. Where perforation seems highly probable, the diagnosis can be positively made on opening an abdomen and finding the leaked-out greenish-blue fluid, previously given by mouth. The perforation can then be readily found and repair effected. In other cases where a plastic fibrinous peritonitis without free fluid in the peritoneal cavity is present the use of coloring matter is particularly helpful in disclosing the site of the perforation.

The following examples illustrate:

Case 1. J. B., a white male, age 43, a teamster by occupation, was admitted to the Cook County Hospital, July 19, 1918, on the service of Dr. Andrews. The examining room diagnosis was acute appendicitis. The patient stated that he had been perfectly well until 4 p. m., July 18, 1918. While at work he was seized with a sharp, piercing pain in the abdomen which doubled him up. He had vomited since the onset of the pain. The vomitus contained food but no blood. The pain had been continuous since onset and was localized to the right side at first, but since then it has become generalized. Patient denied previous ulcer history.

Physical examination revealed a white male of apparent age acutely ill. The abdomen was rigid, particularly on the right side. Tenderness was present over the entire abdomen but most marked in the upper right quadrant and also over McBurney's point. The patient's temperature was 101.2°, pulse 106, and respiration 36 per minute. The white blood count was 13,000. Examination of the urine gave negative result. Examination of the heart, lungs, and extremities was negative. A diagnosis of probable ruptured gastric ulcer was made and the patient was given by mouth 3 grains of methylene blue dissolved in an ounce of water.

At operation a mid-line incision was made. On opening the peritoneal cavity an acute generalized peritonitis was found with free fluid which was stained blue. In the region of the pylorus a large hard indurated ulcer was found, the center of which was perforated and stained blue. Repair of the perforation was effected and the abdomen closed with drainage. The patient made an uneventful recovery and was discharged from the hospital August 19, 1918.

Case 2. W. S., a white male, age 35, a cook by occupation, was admitted to Cook County Hospital, April 4, 1917, on the service of Dr. Speed. The examining room diagnosis was appendicitis. The patient stated that 5 days before admission he had slight cramps in the abdomen which disappeared on taking large doses of castor oil. Twenty-four hours before admission he was suddenly seized with sharp, agonizing pain in the abdomen. The pain was continuous for 5 hours, when it was somewhat relieved by an enema and by inducing vomiting. The vomitus was a bitter, green, thick fluid. Since then he has had continuous pain in the region of the umbilicus. No previous ulcer history could be elicited.

Physical examination revealed a white male of apparent age who did not look acutely ill. There was a slight rigidity over the entire abdomen more marked on the right side. Diffuse tenderness was present most marked on the right side in the region of the umbilicus. There was a slight dullness over the right flank. The patient's temperature was 99.8°, pulse 100, and respiration 22 per minute. The white blood count was 19,900. Examination of urine, negative; of heart, lungs and extremities, negative.

A tentative diagnosis of acute appendicitis was made but perforated gastric ulcer was strongly considered.

One-half hour before operation the patient was given by mouth 3 grains of methylene blue dissolved in an ounce of water.

At operation it was thought advisable to first examine the appendix. This was done. A right rectus incision was made. The appendix was found to be superficially injected but not sufficiently to account for the symptoms. The incision was extended upward. Fibrinous adhesions were found about the liver and gall-bladder with a generalized seropurulent peritonitis and injection of the parietal and visceral peritoneum. On the surface of the stomach near the pylorus a bluish stain was seen.

A perforation about the size of a match head was found. The area surrounding the perforation was hard. The perforation was covered with fibrin so that it was indistinguishable except for the blue discoloration. The perforation was repaired and the abdomen was closed with drainage. Patient made an uneventful recovery and was discharged May 16, 1917.

Case 3. W. C., a white male, age 58, had been in the County Hospital on the service of Dr. Williamson, on treatment for duodenal ulcer. On May 8, 1917, while in the ward he was seized with severe pain in the abdomen. He vomited blood and was transferred to the surgical service of Dr. Andrews, with a diagnosis of ruptured duodenal ulcer.

Physical examination revealed an old man who was apparently in acute pain. The patient looked very pale and was quite weak. The abdomen was scaphoid, very tense, and with almost "board-like" rigidity on the right side. Tenderness diffuse over abdomen. The patient's temperature was 97.6°, pulse 102, and respiration 32 per minute. The skin was pale, cold and clammy. Examination of the heart, lungs and extremities, was negative.

Before operation the patient was given by mouth 3 grains of methylene blue dissolved in a half ounce of water. Operation by Dr. Meyers. A mid-line incision was made and on opening abdomen a bluish green fluid was found. A blue fluid was seen coming from the perforation in the upper anterior part of the first portion of the duodenum. The edges of the perforation were stained a deep blue. An old healed ulcer scar was found near the perforation. The

[1] Published in Surg., Gynec. & Obst., 1917. xxv, 695.

perforation was repaired with interrupted catgut sutures. The abdomen was closed with drainage. The patient made an uneventful recovery and was discharged June 7, 1917.

Case 4. W. H. M., a white male, age 45, was admitted to the Englewood Hospital, with a diagnosis of perforated gastric ulcer. The patient gave a history of gastric distress and pain in the epigastrium of several years' standing. On April 17, 1918, he had undertaken a fasting cure and had lived entirely on water for 8 days. He continued to go to his office every day as usual. On April 26, at twelve o'clock he was suddenly seized with an agonizing pain in the abdomen. The pain was localized about the umbilicus and was so severe that he sought medical advice and he was sent to the hospital for surgical treatment, where a diagnosis of ruptured gastric ulcer was made.

Physical examination revealed a man of apparent age acutely ill. The abdominal wall was rigid. Extreme tenderness was present over the entire abdomen but was most marked in the upper right quadrant. There was no dullness in the flanks. Rectal examination negative. Examination of the urine was negative: of the heart, lungs, and extremities, negative. Temperature 96.8°, pulse 90, and respirations 22 per minute. Before operation the patient was given by mouth 3 grains of methylene blue dissolved in an ounce of water.

Operation by Dr. Weatherford and Mc Quarrie.

On opening the abdomen by a mid-line incision the blue stain was in evidence. Traced up about two and one-half inches it exposed a perforation of an ulcer on the anterior wall of the stomach, one and one-half inches above the pylorus. The ulcer was clearly outlined by deep stain of methylene blue. The edges of ulcer were indurated; the floor of ulcer was very thin throughout its extent. The ulcer was repaired. The abdomen was closed in the usual way, with drainage. The patient made an uneventful recovery and was discharged from the hospital, May 10, 1918.

In all, ten cases have been observed where methylene blue has been used. As pointed out in the previous report, the use of an inert coloring matter has several features of practical value. The chief among these are: the ease and rapidity with which the diagnosis and site of perforation can be determined with minimal shock attendant on the handling of the viscera. The more extended use has shown that methylene blue is particularly helpful, by confirming the diagnosis of perforation, when the abdomen is opened, and by staining the edges of the ulcer, thus readily exposing the site of the perforation.

While it is undoubtedly true that the surgeon can often diagnose perforation by the presence of gastric fluid in the peritonal cavity, any method devoid of danger which will make diagnosis more certain should be used.

NEW WIGHT–HARLOE EMPYEMA SHIELD AND CLOSED METHOD OF APPLYING IT

By J. SHERMAN WIGHT, M.D., and RALPH HARLOE, M.D., Brooklyn, New York
From the Research Department of the Long Island College Hospital

THE shield was designed for the closed method of operating for empyema. It consists of a rubber disc 3 inches in diameter, the concave surface of which comes in contact with the chest. The disc has a periphery with a sharp edge and a stem in the center about half an inch long which is perforated to receive the drainage tube. Figure 1 shows the disc with drainage tube presenting at upper surface. Figure 2 shows the plain edge and thickness of the disc with drainage tube inserted. Figures 3 and 4 show the chest penetrated by the drainage tube and the disc in position.

Fig. 1.

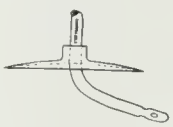


Fig. 2.

Fig. 3.

Fig. 4. Author's bedside empyema operating unit.

Closed method of operating. Under local anæsthesia a small incision is made through the skin at the eighth interspace in the posterior axillary line. A trocar and cannula are inserted, the trocar withdrawn and a drainage tube which just fits the cannula is passed through it and clamped far enough beyond the cannula so that it can be drawn up on the tube and out of the chest. Another clamp is placed on the tube close to the chest to retain the fluid while the first clamp is removed and the cannula drawn off the tube. Rubber paste is applied to the concave surface of the shield and as well to the chest wall.

The shield is passed over the tube, another clamp placed beyond it on the tube and the clamp next to the chest removed so that the shield can be brought in close contact with the chest wall and held firmly in position by broad strips of adhesive plaster pulled firmly around the chest. A pad with a hole in the center is passed over the tube and strapped firmly on top of the shield. The patient then sits up and is ready to have the fluid withdrawn by negative pressure and the cavity irrigated with Dakin's solution. The tube is connected to a suction bottle in which negative pressure is continuously maintained by electrical suction (Fig. 4).

RUPTURE OF THE UTERUS WITH PERITONEAL ENCYSTMENT

By STUART B. BLAKELY, M.D., Binghamton, New York

THE interesting features of the case reported below are: the numerous attempts to produce abortion; a traumatic rupture of the uterus with extrusion of a four months' fœtus into the general peritoneal cavity followed by general peritonitis; recovery from the peritoneal infection, healing of the uterine tear, encysting of fœtus, formation of vaginal fistula; removal of a large portion of the fœtal skeleton with indistinguishable soft parts five months later through the vagina; ultimate recovery.

Mrs. P., age 23; gravida-II. Previous history negative. Last menstruation began September 11, 1918. During the week of December 11 she herself inserted a catheter with stylet into the cervix four times without result. On January 9, 1919, she again inserted a catheter into the cervix, leaving over night, followed by a slight bloody flow without pain. This procedure was repeated the following day with like result. On January 12, the "bag of waters" was

Foetal skeleton removed through sinus opening.

broken by the passage of some instrument through the cervix. This was followed by bloody watery flow, but without pain.

On January 13, under ether some sort of operation was done through the vagina. On recovery from the anæsthetic she felt terrific abdominal pain and flowed profusely. The pain and flow persisted all that day; the patient grew rapidly worse, and the next morning she was transferred to the hospital.

On admission she complained of severe abdominal pain, had a profuse bloody discharge, and presented a temperature of 101°, pulse of 110, a hard distended tender abdomen, vomiting, retention of urine—all the evidence of a severe spreading peritonitis. In view of her extremely serious condition no vaginal or intra-uterine examination or instrumentation was done. Treatment was symptomatic and by antistreptococcic serum. She was desperately ill for one week. External examination then showed a hard tender mass filling the lower abdomen to the level of the umbilicus; by vagina the pelvis was felt to be filled with the same type of induration with no landmarks distinguishable above the cervix. The greatest pain and tenderness persisted on the right side. On January 28, the patient developed a moderately severe left femoral thrombosis, and a sudden profuse, foul, greenish-yellow vaginal discharge. At the end of four weeks the temperature and pulse had become normal, and her condition steadily improved. When discharged on March 8, the abdominal induration had receded to the lower right quadrant; by vagina was felt fixation of the uterus by diffuse pelvic induration with a tender mass in the right pelvis and a retrocervical sinus from which drained a moderate amount of pus. The diagnosis was pelvic abscess with good vaginal drainage.

One month later the vaginal discharge still persisted. Physical findings were practically unchanged, but through the vaginal sinus opening was felt a hard, rough edge that on removal proved to be a portion of fœtal skull. Roentgenogram of the pelvis was negative. However, from responsible sources the information was obtained that no portion of the fœtus had ever been removed. In view of the fact that the patient had had, probably, a streptococcic peritonitis and that her condition was good in every respect, it was deemed best to delay the removal of the fœtus. The patient agreed to return about every two weeks routinely. She had normal menstruation in April and May.

On June 20, 1919, under ether anæsthesia the sinus opening posterior to the cervix was widened, and by means of finger and spongeholder the fœtal skeleton—see illustration—was removed with considerable débris containing bony spicules. The cavity in which it was contained was thick walled with smooth interior lining. All parts could be reached by the finger, and felt clean. Convalescence was without incident and the patient left the hospital on the fifth day.

At present the fixation of the uterus persists, the indurated mass in the right pelvis is much smaller, and a slight purulent discharge continues from the sinus which is now about 2 inches in depth. Nothing abnormal can be felt by abdomen. Her general condition is good; she complains only of occasional pain in the right lower abdomen.

The writer is indebted to Dr. U. S. Kann for the excellent arrangement and roentgenogram of the skeleton.

AMERICAN COLLEGE OF SURGEONS

ANNUAL MEETING HELD IN NEW YORK CITY, OCTOBER 20–24, 1919

PRESIDENTIAL ADDRESS[1]

BY WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

THE American College of Surgeons is beginning its seventh year under most inspiring circumstances. More than three-fourths of the Fellows of the Association have been in their country's service and have returned to their work with renewed vigor and enthusiasm. In spite of the war years, the College has made progress along all lines. The Clinical Congress of Surgeons of North America has been taken over by the American College of Surgeons. In the future the educational, scientific, and moral standards of the American College of Surgeons will be maintained, and only its members and invited guests will be welcomed to the clinical meetings.

Standardization of hospitals has made great progress under the able leadership of the Director of Education, Dr. John G. Bowman. As the result of the efforts of the College, the great majority of hospitals in America of more than 100 beds will institute the restricted staff, and install the laboratory facilities and record systems which the American College of Surgeons believes to be essential.

It is the desire of the Founders of the American College of Surgeons that the association shall be democratic, and that its membership shall be open to all those men of sterling character, ability, and training in general surgery and in the various surgical specialties, who are within the limits of North America. For, when all is said and done, the College stands for service to all the people, and unless a sufficient number of men of high ideals and professional qualifications is eventually secured, the organization will have failed to live up to its great opportunities.

The exact number of men required to perform the duties of caring for the various serious surgical ills of the 115,000,000 people of North America is at this time a matter of speculation and, so far as I know, there are no data on which such a computation can be based. However, an estimated number might be fixed to serve as a target for criticism, of at least one surgeon to 10,000 persons. This percentage is about the same as that furnished to England by the Royal College of Surgeons of London. That there will be, in the next decade, such a number of eligible men, I am confident. Objection has been raised to an association of so large a membership; it is maintained that this would mean a lowering of educational standards. If the principle is established that the association first of all is for the benefit of the people, I believe a working arrangement can be made which will, in a tentative way, meet the requirements. The next generation will not be so greatly troubled as the present one by questions of educational standards. The medical standards of the whole country have been raised to a point not exceeded by those of any other country in the world. In the present generation, by reason of divergent standards, there will have to be a certain amount of latitude to meet the existing conditions.

Knowledge obtained by observation, experience, and from the printed page, is possessed by many men. When knowledge is translated into proper action we speak of it as wisdom. Many men have great wisdom, in their knowledge of useful things, yet may have but a limited book learning. Personally, I believe that the wise honest man who can bring a high order of skill to bear on surgical infirmities should not, at least in this generation, be refused admission to the College because of a lack of fundamental training.

In the adoption of standards or requirements for admission into the American College of Surgeons, character should be first considered. The dishonest, conscienceless man who has surgical skill is most dangerous in any community. Unnecessary operations, even when performed with a high order of technical ability, are the bane of present-day surgery, but, owing largely to the American College of Surgeons, such practices are markedly on the wane. However lenient we may be in estimating the value of the older and disap-

[1] Delivered at the Seventh Convocation, New York City, October 24, 1919.

pearing generation of surgeons, our standards for the younger and coming generation of surgeons, who have had and who will have had opportunities to acquire learning, should be high and increasingly high as future standards and educational requirements are raised.

In the future, the American College of Surgeons will not only demand that the candidate shall be a graduate of a reputable medical school and have had hospital experience and be licensed to practice, but also that he shall have had special training in the particular surgical specialty which he intends to practice. In making these requirements it is the duty of the College to see that facilities for obtaining the special training are developed. Three years at least will be required for such special training. At the present time the man who possesses the B. S. and M. D. degrees and has had one year of hospital training averages 27 to 28 years of age. Add three years to this training and he is 30 to 31. Will this secure the best results or will the man reach his life work at too late an age? We must also consider that during the entire period of his education he is not self-supporting. Will not this have a tendency to make the surgeon a member of an aristocracy to the ranks of which the sons of rich men will be the only ones who will have easy entrance? Investigation was made of the professional standing of the graduates of the medical department of the University of Michigan fifteen years after graduation. It was shown that those who graduated before their twenty-fifth year had made, on the average, greater scientific progress and were a greater asset to their community than those who graduated after the twenty-fifth year.

I think we are all agreed that the actual time spent in the professional part of this education should not be shortened. I think we are also agreed that one of the faults of the educational system of our country is a loss of time and effectiveness in the preliminary educational methods. The university has been made the base of our educational system and it should be the apex. Only a small percentage of those who enter our public schools ever reach the university, yet the university greatly influences the educational policy even in the grade schools. I am convinced that at present two years of time are lost in the grade schools, and that the education given is not altogether the most desirable for the making of American citizens. A six-year course of grammar school education, divested of any university significance, should be a strict government requirement in all schools, private as well as public, and given in the American language. It should be the purpose to give a common education in the common things that are to make us a united people, and such an education might well be made a requisite for the exercise of suffrage.

The high school could be reduced to three years instead of four, and in it for the first time should the university be considered. Languages should be optional in the high school, but I believe that Latin and modern languages are of great value to the professional man. The high school now recognizes the material facts of life, and gives an education in mechanics and agriculture, business, and the industries, as well as the traditional cultural education, and these courses should be further extended.

It is sometimes difficult to follow the academic mind. The more or less cloistered life that is led by many college professors has given traditional cultural education too great an influence. Modern educators today do not believe that teaching in one subject as, for instance, mathematics, has greater power of mental training than other subjects. The old time educator would consider this rank heresy. His mind still clings to the view that any education which might be used commercially is not cultural, a view which is wholly undemocratic and based on an out-worn caste system.

In no place has this traditional view of education been more pronounced than in the universities. It has been only within recent years that the university faculties would accept the view that the anatomy and physiology of man had cultural training value, although they were convinced that the anatomy and physiology of plants had such value. There has been a slowness of universities to give credits for any kind of work which might be used for gaining a livelihood, even so holy a cause as caring for the sick. And today, less credit is given in these subjects than for others which have no more training value. Do not understand me as desiring to lower the standards of universities in relation to cultural education. Far from it; but I do object to the present attitude which desires to force every type of education into the one mold. The great problem now is to obtain the money to give an education to all those who desire it. The purpose of the university is to give an education not to the few, but to the many; and it should be emphasized that the giving of degrees is only incidental to this purpose. Every unnecessary step, every unnecessary regulation which delays or obstructs the progress of a student prevents some one else from obtaining an education. The academic answer is: Raise standards until the number of those

who can—not desire, but can—obtain an education is reduced to the number who can be given the present form of education. Our country depends not on a cultured class alone, but on the average intelligence, and in the last analysis on the number who will be able to obtain an opportunity to get an education. It should be the duty of the Fellows of the American College of Surgeons to see that certain existing conditions be remedied so that the medical schools may graduate their students at an earlier age.

In this connection, I quote from the 1918 report[1] of C. G. Schultz, superintendent of education of the state of Minnesota, now of the Government Department of Education, Washington:

"It requires a total school enrollment of approximately four hundred fifty to produce one college graduate. No one questions that it is desirable that this one graduate should be produced. But that a large part of the energies of a school community should be devoted to this end seems lacking in sound business sense. Surely such a procedure in no way contributes to the fulfillment of our democratic ideal of the open door to equal opportunity. In order that we may prepare one pupil for college we cannot justify the neglect of those forms of training distinctly desirable for the four hundred forty-nine who must follow pursuits other than those open to the college graduate. The same reasoning leads to the conclusion that we cannot justify our insistence upon the maintenance of high schools for the sole purpose of training all pupils to go to college when only one out of ten goes and only one out of thirty graduates."

The expense of our educational system is a serious burden on our taxation resources. By efficient methods a much greater percentage of our young people might secure higher education without an increase of the present burden. The average child should not be entered in the common school under the age of seven, but should be taught in the kindergarten, given six years in the grade school, and three in the high school. At sixteen the student who desires it is ready for university training. The freshman and sophomore years, under university supervision, may be given in the home high school under home influences. At the more mature age of 17 to 18 the students leave for the junior and senior years in the university. Such a program contemplates cutting only three years from the grade and high schools, does not increase the cost, and doubles the capacity of the university for the giving of advanced education. This is not purely theoretic; such university high school courses are now given with university credits in some of the cities of Minnesota, among others Rochester, where C. H. Mayo, as one of the city school commissioners, has made the plan a success.

Another problem for which some wise solution must be found is the future management of the annual clinical meetings of the association. Even at the present time, with a limited membership, there are few cities in this country that can adequately care for the visitors at the meetings. It may be that a partial solution will be found in the development of clinical meetings to be held in various states or parts of the country in addition to the annual meeting for the convocation. It has also been suggested that the attendance at the annual meetings shall be limited to the members of the association, but, inasmuch as it is our intention to make the fellowship the first goal of the ambitious young surgeon after the completion of his training, it would seem that, so far as possible, promising young men should be admitted as invited guests.

In developing the sectional clinical meetings it should be borne in mind that the essential idea is educational—to develop better surgery. We must, however, remember that we, as a College, have a duty to perform to the public and to the profession, and this can best be brought about by close affiliation with the organizations representing medicine as a whole. We urge upon every Fellow that he become a member and a conscientious worker in his County and State Societies, and in the American Medical Association.

Men who cannot become fellows because of lack of moral character should not be allowed to give demonstrations or hold clinics under the auspices of the College.

Finally, I would call attention to the desirability of making the College of Surgeons truly American, by affiliation with the universities of the sister republics in South America. The University of Lima, Peru, is the oldest university in America, and many of the South American universities have attained pre-eminence as educational institutions, with whom it would be of great benefit to be associated. I am sure a way will be found to consummate so desirable an alliance.

[1] Twentieth Biennial Report, Department of Education Minnesota. 1917-1918

THREE RECENT EPOCHS IN THE HISTORY OF THE CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA[1]

By JOHN G. CLARK, M.D., F.A.C.S., Philadelphia

THE Clinical Congress of Surgeons of North America has participated in two epochs world-wide in their tragic importance, within the last three years. The first marked the entrance of the United States as one of the Allies in the Great War; the second witnessed the frightful epidemic of influenza last year; and we are now standing upon the threshold of the third, or transitional event—a new era in American medicine.

The session two years ago in Chicago was of a highly inspiring character, for this great organization, constituting a guild of our best and most earnest surgeons, was stirred to the very acme of patriotic enthusiasm by the events which transpired at that meeting. In addition to the Secretary of the Navy, three of our Surgeon-Generals and other distinguished figures in surgery, who had been known to us as skilled masters in our profession in civil practice in their respective countries before the war, came to us as military ambassadors, bearing messages of grateful appreciation from their countries for the magnificent effort we were then displaying in the organization of a virile Medical Corps to replenish the sorely depleted surgical ranks of the war ridden zone.

After that remarkable meeting, our foreign guests returned to their homes, carrying a revivifying inspiration to their wearied armies, for they had witnessed the awakening of a lusty national giant from a lethargy of neutrality. Out of this association went the surgeons who became the very heart of the Medical Corps, and sitting in the audience this evening are innumerable Fellows who have returned to us decorated with the highest honors, bestowed by our own and grateful allied nations.

Indefinitely could one dwell upon the glorious deeds of our Medical Corps, but others will pay a more worthy tribute to our heroes than is possible for me to express. During the year following the Chicago session, our Secretary General, Franklin Martin, the genetic and dynamic force behind this organization, although engrossed with the many difficult tasks of his high office as the medical member of the Council of National Defense, was working indefatigably upon the details of the forthcoming New York meeting. Again were delegated to this country from the Allied nations many distinguished surgeons from England, France, Italy, and Belgium, but after that delegation had set sail for New York, the outbreak of influenza, which developed into a veritable pestilence, fell upon this country and became especially virulent upon the Atlantic seaboard. Notwithstanding our Secretary General had previously been importuned to let the meeting lapse on account of military exigencies, the urgent opposition of mere man could not thwart his Jacksonian tenacity, but he was forced by this frightful interposition to capitulate. Only those who know his continuity of purpose and how persistently he worked for the success of that meeting can realize with what reluctance he prorogued that session until this year. However, he, with the co-operation of your new President and our New York hosts have arranged for this week a bigger and better clinical program than ever before. The loss of last year, therefore, is amply made good by the excellent series of papers and clinics, which will be given by the New York and Brooklyn surgeons to our Fellows and guests.

With the outbreak of the epidemic of influenza began the second noteworthy epoch in the medical history of our country, a period filled with appalling issues. The physicians at home were heavily burdened with the added cares of their absent colleagues, and were almost overwhelmed with the searching trials that followed.

In addition to the established hospitals, churches, warehouses, and armories were hastily equipped as emergency hospitals and our physicians and nurses served quite as valiantly and many died as nobly at these posts of duty as did the heroes of the Argonne. Two great armies of physicians were then at war—one making the great sacrifice in honor of their country—the other in sustaining our national civic life, so necessary for the construction of an impregnable industrial and financial bulwark behind our armies. The medical profession has emerged gloriously from these two colossal crises, and we are now on the threshold of the third great epoch—a new era in American medicine.

The European nations are grievously impoverished, and their great educational systems must of necessity suffer for at least a decade before recovery is possible. They have sustained

[1] Address of retiring president, New York City, October 20, 1919.

an irreparable loss in that youthful spirit which Sir William Osler has so wisely said is essential for inventive progress, and it will require at least twenty years to restock the scientific storehouses in those countries to which we formerly made our postgraduate pilgrimages. Are we prepared to carry on while they recover? If not, we will lose one of the inestimable opportunities that this war has thrust upon us. We Americans do not deliberately seek scholastic ascendancy over any other nation, for we have witnessed the frightful havoc wrought by an egotistic "kultur," but we are in duty bound to fill the gap and to score an advance in progressive medicine while the scientific ranks of Europe are being regenerated.

With the completion of our martial activities, great numbers of young surgeons have returned and many have eagerly resumed their places in our schools and hospitals as teachers, invigorated with new ideals and filled with youthful energy to pursue them. Many other returning physicians, who have found themselves through the mighty force of circumstances created by their war activities, are newly possessed with a desire to take up intensive study in various special branches, so that they may better their positions in medicine, instead of falling back into the humdrum of small practice. It requires no prophetic vision to forecast what will transpire when our greatly augmented transportation fleets again take their places as the carriers of international commerce, especially to our South American neighbors. There will then be an influx of students from the southern countries, both to our undergraduate and postgraduate schools. To such men we should be prepared to offer ample facilities for postgraduate study, not of the old commercial type, such as our schools have been guilty of purveying in the past, but a full and comprehensive training of sufficient length to lead to a master's degree. The wretched postgraduate instruction of past years should be cast into the discard and courses should be arranged of such essential value that upon their completion by a student his diploma or certificate will be a real and trustworthy evidence of his ability to practice in that special branch. The six weeks', or even the six months' course of previous years was little less than a "bunco" game, in which the postgraduate student was given a smattering imitation of knowledge, and he in turn went into practice delivering the same deceptive article to his patients. It has been said that the patient who pays five or ten dollars as an obstetric charge is usually cheated, so likewise is the postgraduate student dealt with who takes a six weeks' postgraduate course, be his tuition fee small or large.

We have spoken much in this country of research, and, under the guidance of a false stimulus, men have attempted to carry on phases of investigation who are as capable of attaining a successful issue as a farm horse would be of winning the Royal Derby. Although the great geniuses of science have brought forth their epoch-making discoveries under the most adverse circumstances, and such geniuses will still attain pre-eminent places in the scientific firmament under similar difficulties, the average investigator, however, cannot work against such obstacles and achieve results. Fortunately, there have sprung up in this country a few special laboratories and hospitals in which men capable of real research work may be trained. That the number of such institutions must be increased is absolutely essential for a stable scientific growth. Out of every medical class of one hundred there may possibly be but one graduate who really has a creative mental capacity or bent for scientific investigation. These men should be segregated and fed upon such mental pabulum as will bring out their best capabilities, and while pursuing this work they should be shielded from the carking cares of earning a livelihood by liberally endowed scholarships. As directors of departments of research, men of broad training and culture are required; those, who through copious fertility of ideas, are always ready to direct the scientific pioneer along lines that are most likely to lead to valuable discoveries.

The new epoch, therefore, should become the renaissance in American Medicine, combining all of the sterling qualities of our intensely practical natures with that fine sense of research and investigation which shall make so much more comprehensive and also more efficient the medical education of the coming generation of physicians.

REPORT OF THE SECRETARY GENERAL OF THE CLINICAL CONGRESS OF THE AMERICAN COLLEGE OF SURGEONS AND OF THE AMERICAN COLLEGE OF SURGEONS

I. Organization of the Congress and the College
II. The Permanent Administrative Home
III. Endowment Fund
IV. The Work of the College

By FRANKLIN H. MARTIN, M.D., F.A.C.S., Chicago

IT is desirable in this, the annual report of the Secretary General, to summarize briefly the paramount developments in the organization and administration of the Clinical Congress and of the American College of Surgeons since their inception. This is particularly appropriate inasmuch as we have been so preoccupied with war problems during the past three years that the exigencies of the situation have prevented a detailed report to the Fellows since November, 1916. This does not imply, as this report will endeavor to demonstrate, that the work of the College has been neglected for this period of time, nor that we have failed to carry out many of our original plans.

I. Organization of the Congress and of the College

The organization of the Clinical Congress and of the American College of Surgeons was not an accident. Fundamentally, surgery is a mechanical art, and its intracacies can be adequately illustrated only by a master of the art, through actual exhibitions of his work at the operating table in the hospital. Several great clinics of the world had demonstrated the value of this form of teaching, and a group of our wisest men had made it the basis of an exclusive travel society of surgeons. The superiority of clinical demonstrations as a means of interesting surgeons in surgery compared with the usual academic society proceedings with scientific papers and discussions made obvious the fact that this clinical society could not be confined to a group of half a hundred men. This recognition resulted in a meeting of a large number of the surgeons of the country to watch the leaders of one of our great medical centers do their work in their accustomed environment. The outgrowth of this assembly was the organization of the Clinical Congress of Surgeons of North America, the first natural step in the creation of the American College of Surgeons.

As a supplementary control of the informal clinical society, the College was inevitable because of the popularity of this form of society and its appropriateness in imparting information about surgery. It soon became obvious that no single clinic, nor all of the clinics of any large city, could accommodate the aspiring surgeons of the country who desired to attend the meetings; and because of the variety of surgery shown at these informal meetings, it was made equally apparent that if we were to reap the maximum benefit from the clinical meetings, it would be necessary to standardize the surgery that was exhibited at these sessions. These facts argued for an organization that would establish for its Fellows a minimum standard of education, ethical status, and technical capabilities; that would aid in limiting unnecessary surgery and work for the making of better surgeons in all communities. It was suggested that the roll of membership should contain only the names of those surgeons who would subscribe to these principles, and who, in the estimate of their associates, would seek to sustain them. As the result, at one of the greatest meetings in the history of the Clinical Congress, with twenty-six hundred surgeons in attendance here in New York in 1912, the new society to be known as the American College of Surgeons was created from the loins of the Clinical Congress, and the plan of procedure was announced from this platform. A strong committee with power to act was appointed by the President of the Congress to consider the advisability of establishing an American College of Surgeons. This committee forthwith took charge of the proposed organization, and its development was begun.

In May, 1913, at Washington, five hundred surgeons of the country who were agreed that the development of the idea was desirable assembled and formally launched the American College of Surgeons. The College became a reality in November, 1913, one year from its

birth, when, under the approval and god-fathership of the then President of the Royal College of Surgeons of England, Sir Rickman J. Godlee Bart., the first Convocation was held, and the Fellowship of the College was extended to ten hundred and fifty-nine surgeons. Ten hundred and sixty-five Fellows were enrolled in June, 1914, in Philadelphia; six hundred and forty-six in Washington in the Fall of 1914, and a smaller number each year thereafter, until with this year when the Roll of Fellows of the College comprises over four thousand surgeons of the United States and Canada.

SELECTION OF MEMBERS

The selection of members for the society from among the thousands of applications on file necessarily required the most judicious handling. This involved considerable preliminary work in fixing standards, and creating machinery of administration that would act efficiently, effectively, and disinterestedly. This second stage of organization may well be called the epoch of personnel.

FINANCING THE ORGANIZATION

The epoch of financing was the third undertaking. It soon became apparent to the officers that the original plan of financing the organization was entirely inadequate to cope with the educational responsibilities that were thrust upon the College. The contribution by each member of fifty dollars outright, or at his option paying a twenty-five dollar initiation fee and five dollars for five years thereafter, would merely provide for the routine administrative expenses and would be insufficient to finance an educational campaign which would require a corps of paid experts and other machinery of propaganda. It was, therefore, proposed at the Philadelphia meeting in 1914 that an endowment of one million dollars, in five hundred dollar units, be subscribed by the Fellows of the College before November, 1914. Because of the uncertainties which resulted from the precipitation of the European war, in August, 1914, the Regents asked for an extension of the time limit to November, 1915. This extension was granted by a referendum vote of the Fellows who had already subscribed to the fund. As a consequence, at the expiration of the new date the five hundred thousand dollar fund was oversubscribed by thirty-six thousand dollars.

In the meantime, many suggestions came to the Regents from the Fellows in regard to the equalization of the financial responsibility. At the Philadelphia meeting in October, 1916, a resolution embodying these suggestions was put to a vote of the Fellows, namely, that those who were not subscribers of a lump sum to the endowment fund should pay twenty-five dollars a year dues, such payments to be made until the Fellow had reached the age of sixty-five, or until he had contributed an aggregate sum of five hundred dollars; that the Regents be authorized at their discretion and without publicity to cancel the dues of any Fellow to whom such payment would be a hardship; and that all Fellows who had subscribed five hundred dollars to the endowment fund be exempt from dues. This resolution was unanimously adopted.

II. The Permanent Administrative Home

Since the inception of the American College of Surgeons, a paramount problem in its organization has been the one of fixing its permanent central administrative home. From the beginning, in the minds of its friends and organizers, the American College has been compared with the Royal College of Surgeons of England, with its nine centuries of accomplishments; its dignified home in Lincoln's Inn Fields, London; its Hunterian Museum; its great medical library; its collection of paintings and busts of the men who made the history of surgery; and its storehouse of traditions of unprecedented value. The American College of Surgeons, comprising the surgical profession of the United States and of Canada, and representing a population of one hundred and fifteen million people, must, they conceived, have a home which will compare favorably in dignity and importance with that of its predecessor in England; and while the counterpart cannot vie with the original in traditional treasures, it can offset these by compensating advantages that accrue to the College because of its greater field of activity and its newer methods of attack.

Confronting the Regents at the outset in the consideration of a permanent home was a threefold problem—location, financial means, and scope. The most important phase was the location, because of the inevitable spirit of contest that necessarily ensues when many individuals having varying ideals and residing in widely different areas are to be satisfied.

At the Philadelphia meeting in 1914, the Regents, as the result of a spirited discussion of the subject of a permanent home, appointed a committee to consider the matter, with Admiral Charles F. Stokes, formerly Surgeon General of the United States Navy and a resident of Washington, as chairman. This committee

presented a tentative report at the Washington meeting of the College in 1914 which distinctly favored Washington as the home of the College inasmuch as it is the capital of the United States, the center of population of the East, and a distinctly neutral ground. While the report was tentative and not supported by a definite recommendation, it was loudly applauded by a large number of the Fellows present. It was not, however, made a subject of vote because it had not received the cordial endorsement of all of the Regents.

The subject of location was discussed by the College from three principal standpoints: First, should the home be situated in a medical teaching center? Second, should it be in the capital of the nation, which would also have the advantage of neutrality? Third, should it be in a geographical and medical teaching center of the United States? The greatest difference of opinion in the minds of those who discussed the matter at all seemed to be between the capital of the United States and one of the medical centers. After the aforementioned Committee had submitted its report and recommendation, the subject of the future home of the College aroused an interest among many Fellows who had previously given it but little thought, and it became apparent that an opinion was developing which more and more favored one of the medical centers.

In the meantime the European war, since it was inevitable that we were to be drawn into it, was occupying our minds, and the problems of our medical societies and of the College were temporarily dwarfed.

CREATION OF THE JOHN B. MURPHY MEMORIAL ASSOCIATION

But the horrors of an European war could not distract us from the great loss that the medical profession, and especially the surgical profession, of the world sustained in the death of one of our most distinguished Fellows and one of the most influential founders of our College, Dr. John B. Murphy. His death, occurring as it did at the height of his activity and influence, brought us face to face with the mutability of our transient problems. It also brought vividly to the minds of his nearest friends his transcendent interest in the American College of Surgeons, and his regret that, at the time the permanent location of the College was discussed, Chicago, the city in which he had done his work, was not even seriously considered. But before he had been laid to rest, a host of his lay friends were discussing and planning a suitable memorial for this great man—something other than bronze or marble; something connected with his life's work; something useful; something essential; something enduring; something in Chicago.

The suggestion that in the permanent home of the American College of Surgeons a memorial hall bearing his name be dedicated to his memory, as the Hunterian Museum of the Royal College of Surgeons commemorates a leader of surgery of England, appealed to these friends, and an organization known as the John B. Murphy Memorial Association was immediately incorporated. The plans of this Association contemplated securing from the municipality of Chicago or the citizens of Chicago a gift of land on which could be built the first unit of the future home of the American College of Surgeons, the buildign to be known as the Murphy Memorial of the College.

It was obviously necessary that the tentative plans of this organization should be immediately considered by the College and a decision efinitely rendered. It was mid-August and the Regents were scattered, enjoying their vacations. The Chicago contingent—the Treasurer, the Director and the Secretary General—realized that favorable action could not be authorized in the tentative emergency offer of the Memorial Association without the consent of the Regents of the College. The Director and the Secretary General visited the President of the College in Nova Scotia, and in accordance with the program which was formulated at this interview the Board of Regents met on call in New York City on September 20, 1916, with the following members present: Edward Martin, George E. rewer, Frederic J. Cotton, Charles F. Stokes, BGeorge W. Crile, Charles H. Mayo, J. M. T. F nney, and Franklin H. Martin. The plan of thei Murphy Memorial Association to locate the College in Chicago on a suitable site that would be furnished to the organization without cost, and on which would be erected one of the first structures or units of its home, to be known as the Murphy Memorial, was presented in detail and was unanimously approved. The Regents realized, however, that their judgment should be confirmed by a referendum vote, accorded to all the Fellows. This was done by mail and out of 1865 votes cast, 1550 favored Chicago, the 315 scattered votes favoring other cities.

The Memorial Association perfected its organization. Then occurred our entrance into the world war. The President of the Association, Mr. Hurley, was placed at the head of the United States Shipping Board; Judge John Barton Payne, a member of the association, be-

The south and west exposure.

came chief counsel for the same Board, and other members were called to Washington for an indeterminate period. Seventy-five per cent of our Canadian Fellows were already in France; in six months fifty per cent of the Fellows of the United States were in uniform, and fully thirty per cent additional were doing other important work for their country. For two years all work of the committee was necessarily abandoned.

With the signing of the Armistice, however, the frayed ends of peace-time were gathered up. It had been deemed possible that a site might be given to the College by the park commissioners of Chicago. Later, however, it developed that such a location might be attended by many legal difficulties, and might at some later day involve the College in undesirable political complications.

POSSIBLE SITE IN CHICAGO

This view of the situation, substantiated by the best legal advice that could be secured, was imparted to the Regents at their meeting in Atlantic City in June, 1919, with the suggestion that the College accept, in lieu of a location in a public park of Chicago, a suitable site purchased by the citizens of the city and made an outright gift, free from all entangling alliances, to the College.

In the discussion that followed, it was made clear that the Regents favored the selection of a medical center rather than a neutral city. This opinion, supported by the referendum of the Fellows which had definitely favored Chicago, determined the Regents to authorize the Secretary General to negotiate for a site in Chicago which was already under contemplation, and to accept it in the name of the College as a gift from the citizens and Fellows of that city. A time limit of sixty days was given the Secretary General in which to accomplish this work.

A purchase price was secured, and on July 1, 1919, after consultation with and obtaining the approval of the President, the Treasurer, and the Director, the Secretary General took a forty-five day option, the utmost that could be obtained on the property that was afterward secured, and immediately proceeded to raise the money for the purchase. August 15th was the last date on which the option and the five thousand dollar guarantee could be redeemed.

The price placed on the property was one hundred thousand dollars, which was practically the value of the land. The property surrounding the site is in the process of transition from the most exclusive residence district of Chicago to that of high-class hotels and apartment buildings. Therefore, when the land is sold for business purposes, these residences are considered a liability rather than an asset, because of the expense of

The south and east exposure showing vacant portion of lot available for future improvement.

wreckage. Many of them, including the one secured by the College, cost fabulous sums to build thirty years ago. Inasmuch as the building that goes with the College property is occupied now as a residence by the people who have owned it for many years, it has been kept thoroughly modernized and is in a perfect state of preservation.

To facilitate our campaign in raising the money, we divided the amount into two parts—seventy-five thousand dollars and twenty-five thousand dollars. We honored the millionaires by assigning to them the larger sum, and insisted that the Fellows of the College living in Chicago be content to contribute the smaller amount. The Association of Commerce interested itself in our task and gave us not only good advice but material assistance in planning our campaign. The real raising of the money, however, came by hard work in the way of personal solicitation. Two days before the option expired we were thirty thousand dollars short of the necessary amount. On Saturday, August 15, two days later, we had to give notice of acceptance of the property or lose it, with our deposit. While there were a number of good prospects in sight, actual subscriptions were not in hand. To fulfill to the letter our instructions from the Board of Regents, as recorded by their vote, the accepted site must be guaranteed to the College without a cent of the purchase price coming from that institution. The Secretary General took the matter to the Treasurer; what could be done to save the seventy thousand dollars already subscribed and to secure the home of the College? It was decided that the Treasurer and the Secretary General should personally underwrite the outstanding balance, and notice of the purchase of the property was given. Today the deficit on the guarantee is eleven thousand dollars. A number of good prospects are being followed up, and there is no doubt that the whole amount will be subscribed before December 1, and the underwriters of the diminishing deficit released.

In the meantime title to the property has been taken in the name of the College, and sixty thousand dollars paid on the contract. The house has been rented to the late owners and present occupants until March 1, 1920, for a sum considerably in excess of the rent that we are now paying in our temporary quarters. The property which has been purchased for the College is located on the northeast corner of Cass and Erie Streets. The building faces Erie Street and is a block and a half west of the main driving thoroughfare, Lake Shore Drive, with a two-minute bus service from and to the loop center; it is one block east of North State Street, with a through line of trolley cars; it is less that a mile from the most distant hotel; it is a five to ten minute walk

The lower entrance hall.

from the loop. The lot has a frontage of one hundred and fifty feet on Erie Street, and a depth on Cass Street of one hundred and nine feet. It occupies the south-west one-fourth of the block, giving the building a south and west exposure. The present building, occupying sixty-five feet of the lot and extending its full depth, was built thirty years ago at a cost in excess of four hundred thousand dollars. The building has a three story and basement elevation, and is constructed of steel, Bedford stone, bronze, and marble; it presents the dignified appearance of a building erected for semi-public and semi-business purposes, is thoroughly fireproof throughout, and is eminently suitable for the purposes of the College. The present owners have within the past ten years spent a considerable sum of money in adding a new heating plant, an up-to-date lighting system, and other modern improvements. There is sufficient vacant space upon the property to meet our future needs, including the Memorial Hall, and in case of extraordinary expansion additional ground may be secured.

In taking stock of this possession which has come to the American College of Surgeons through the generous gift of the lay and professional citizens of Chicago, we find ourselves greatly enriched in the needed assets of the College. Our present temporary quarters are thoroughly inadequate, and with a renewal of the lease, which would have been necessary in May, our rent would have been increased to six or seven thousand dollars a year and we would still have been handicapped by a makeshift. The new building furnishes immediately a dignified clearing house for our organization, and administrative offices that will be adequate for its purposes for a great many years. If the building had been erected to supply the administrative needs of the College for fifty years to come, it could not have been a more convenient structure than this in points of space and arrangement of rooms. However, we are not providing for the immediate present alone in obtaining this property but for the remote future, and we have the satisfaction of knowing that our holdings will advance rapidly in value since the next extension of the business loop in Chicago will in all probability include our property.

Having provided for our immediate administrative needs in this present building, what will be our subsequent moves? First, the building of the Memorial Hall and accessories; second, the establishment of a working museum, with its building and upkeep independently endowed; third, also through independent endowment, the establishment of a department of literary research, either with or without a medical library.

The upper hall.

The drawing room and library.

The library and den.

III. Endowment Fund

The fourth problem which the Fellows of the College should bear constantly in mind is the completion of our one million dollar endowment fund. One thousand and twelve men of our four thousand Fellows have subscribed five hundred dollars each to the endowment fund. This fund is a permanent one, invested in municipal and government bonds, only the interest of which can be used to defray the expenses of the College. No part of the principal may be spent for land or brick and mortar. Those Fellows subscribing to the endowment are exempt from the payment of dues. It is hoped that a considerable number of the three thousand Fellows who have not subscribed to this fund will do so in order that we may reach our goal, and still further substantiate our organization.

IV. The Work of the College

The postponement within a fortnight of its opening of the session of the Clinical Congress last year, because of the influenza epidemic, was a great disappointment because of the work that had been so painstakingly accomplished by the untiring Committee on Arrangements of New York and by the officers of the Congress; also it deprived the Fellows of the College and the members of the Congress of the usual valuable inspiration that these meetings impart.

Credentials Committees

As the result of an unlimited amount of work, the State and Provincial Committes on Credentials have added to our list a large number of Fellows. There are now on file in the office of the College approximately five thousand names of applicants. The Credentials Committees and the Committee on examination have pursued their work conscientiously. The fact that less than one hundred and fifty candidates have been admitted to Fellowship this year out of the large number of applicants argues for the thoroughness of their work. As proof that the small number of

The library and den.

The directors' room

Fellows admitted is not due to default of enterprise on the part of the Committee on Examination we have only to state that out of every one hundred sets of examination papers reviewed by the Committee less than fifty were approved. Many of the candidates who have submitted case reports have been notified of minor errors and have been asked to resubmit papers or to revise or supplement their original ones. The office has endeavored to deal punctiliously with all candidates in giving them information, through correspondence or by personal interviews, and as far as practicable in giving them the status of their candidatures.

The report of the Director will record the campaign on hospital standardization which has extended over a period of three years. The survey furnishes material that should establish the authority and right of the American College of Surgeons to pursue and guide the program that it has so effectively established. The definite plan that is laid down for the guidance of all who are interested in hospital standardization is particularly acceptable at this time. It states what has been accomplished, what should be accomplished, and outlines the means of accomplishment. The minimum standard on which this survey has been conducted is clearly defined. The general hospitals of the United States and Canada which are known to meet the minimum standard established by the College are recorded by the College for future announcement. Out of a total number of 617 general hospitals in the United States having a capacity of one hundred beds or more, 190 are listed as meeting the minimum standard, while out of a total of 34 of such hospitals in Canada, 8 are recorded as meeting the standard.

SECTIONAL CLINICAL MEETINGS

In addressing the five hundred Congressional Representatives of the United States and of Canada in twelve separate groups in the last two days, it has developed that there is a strong desire on the part of this decentralized part of our organization to establish sectional clinical meetings. This proposition has been discussed by the Regents, and a meeting of the Executive Committees of the Congressional Representatives of the various States and Provinces will be called at some central place within the next month or two to discuss and adopt a uniform plan to be followed in the organization of the state or sectional clinical meetings.

PRESENTATION AND ACCEPTANCE OF THE ADMINISTRATIVE HOME

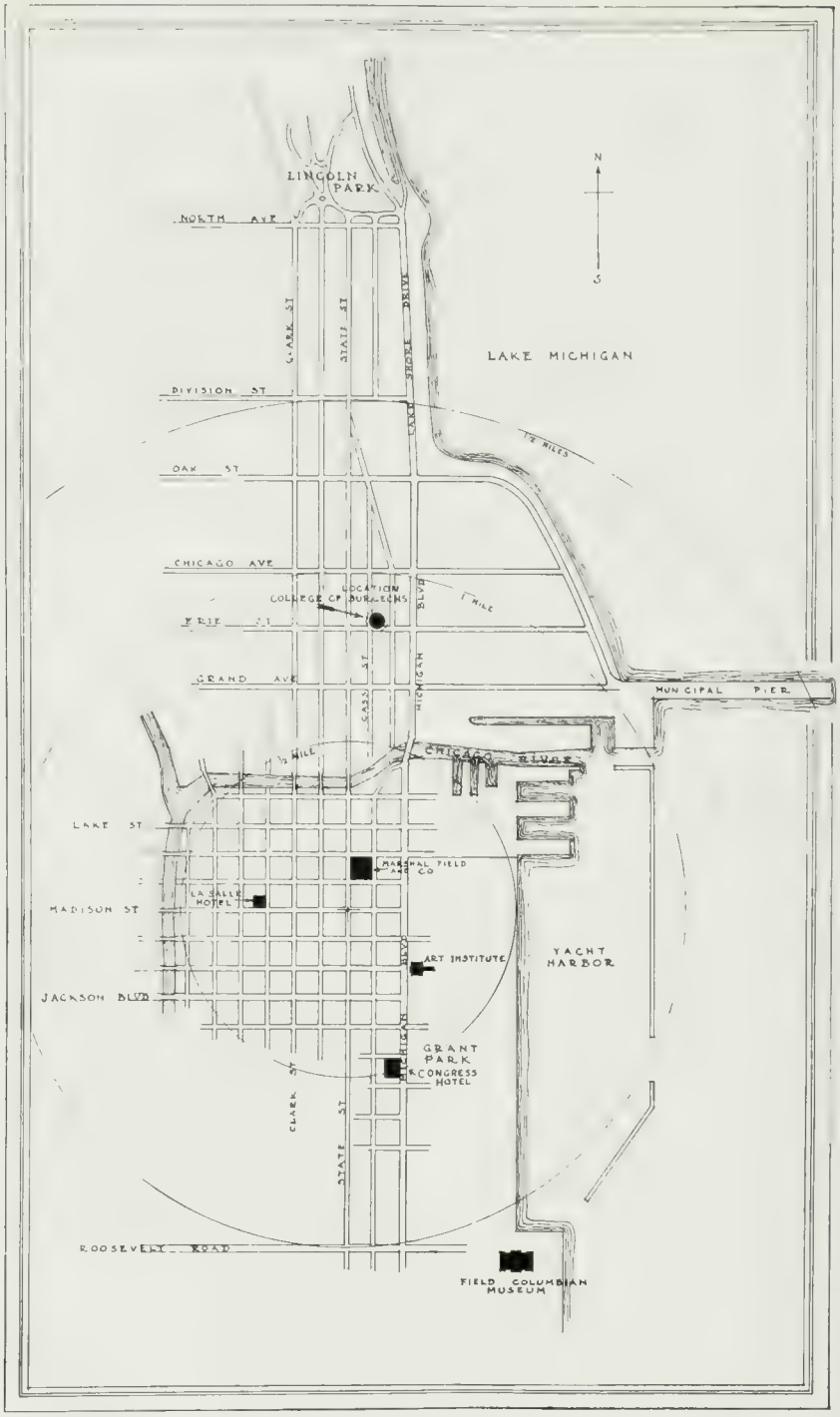
At the conclusion of his report the Secretary General presented to the President and to the Fellows the gift from Chicago citizens and members of the College of the property and building at 40 East Erie Street, Chicago, described above to be used as the permanent administrative home of the College. Dr. J. M. T. Finney, upon request from the Chair for a resolution concerning the gift, made the following motion:

WHEREAS, the citizens of Chicago have presented to the American College of Surgeons, for a permanent administrative home a site and building at 40 East Erie Street, Chicago,

BE IT RESOLVED, that this site and building be accepted and a suitable letter of thanks expressing appreciation of the gift be drafted and forwarded to the citizens of Chicago.

As one of those who from the start had consistently favored Washington as the site of the permanent home, Doctor Finney, upon the seconding of his motion, asked for the privilege of making a few remarks concerning the resolution he had just proposed. He said:

"There has been some misapprehension in the minds of a number of the Fellows as to where the College really stood on the question of the location of a home, and it affords me great pleasure to offer a word of explanation in order that this misapprehension as to the facts of the matter may no longer exist. The Committee appointed to consider a site for the College favored on the whole the City of Washington, although they could come to no unanimous decision. At the annual meeting held in Washington, November 16, 1916, the feeling of the Board of Regents was not in perfect accord concerning the site, and, therefore, as President and presiding officer, I did not ask for a vote. Subsequently the matter was thoroughly discussed at various meetings, and in June, 1919, in Atlantic City, five Regents who had previously favored Washington unanimously and enthusiastically voted in favor of Chicago. The experiences of these men in Washington and in Europe during the War brought them to the conclusion that while there were obvious advantages in the Capital as the governmental and political center of the country, there were more definite and potent reasons why it was unsuitable for the permanent home of the College. Furthermore, the vote by letter of the



Plat showing location of new home of American College of Surgeons in relation to business section of Chicago.

Fellows was overwhelmingly in favor of Chicago, and the offer at this time of the splendid property just purchased seemed so opportune and advantageous that, since there was no good reason for holding out, it seemed clearly a duty to reach a decision, and that decision was in favor of Chicago."

Doctor Finney's motion carried unanimously.

COMMITTEE ACTIVITIES

AUDIT OF ACCOUNTS OF THE CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA AND OF THE AMERICAN COLLEGE OF SURGEONS

The president of the American College of Surgeons deemed it advisable to review the affairs of the College and of the Clinical Congress of Surgeons of North America in order that their organic union might start with full knowledge of the financial and business status of both organizations. He therefore appointed an auditing committee of five with authority to make this survey. It met at the offices of the College on December 31, 1917, and after a thorough examination of all books, papers, and records concerning the business of the American College of Surgeons and of the Clinical Congress of Surgeons of North America, submitted the following report:

We, the Auditing Committee of the American College of Surgeons, find the accounts of the American College of Surgeons and of the Clinical Congress of Surgeons correct in all respects, the methods of bookkeeping accurate, and proper vouchers and receipted bills for all moneys paid out. Money has been spent only with proper authority and for value received.

We desire to express to Dr. Franklin H. Martin, secretary general, our appreciation of the vision, courage, and sincerity with which he originated and developed the American College of Surgeons and the Clinical Congress of Surgeons of North America, and brought to a consummation the recent absorption of the latter organization by the former. The records show that Doctor Martin has at great personal sacrifice both of time and money made this result possible. We also wish to acknowledge our debt of gratitude to that master surgeon, the late Dr. John B. Murphy, for the aid he gave in promoting higher surgical education and fostering purer professional ideals.

(Signed) William J. Mayo, *President*
William W. Pearson
Miles F. Porter
Arthur D. Bevan
George David Stewart

APPOINTMENT OF COMMITTEES

Committee on Industrial Surgery — Edward Martin, Philadelphia, chairman.

Committee on Military Preparedness — Joseph A. Blake, New York, chairman.

Committee on Post-Graduate and Research Work — John G. Clark, Philadelphia, chairman.

REPORT OF NOMINATING COMMITTEE

The report of the Nominating Committee resulted in the election of the following:

President: George E. Armstrong, Montreal.
First Vice President: Rudolph Matas, New Orleans.
Second Vice President: Horace Packard, Boston.

BOARD OF REGENTS

Term Expiring 1920: Robert E. McKechnie, Vancouver; William D. Haggard, Nashville; George E. Brewer, New York; William C. Gorgas, New York; William J. Mayo, Rochester; Franklin H. Martin, Chicago.

Term Expiring 1921: Alexander Primrose, Toronto; Albert J. Ochsner, Chicago; George W. Crile, Cleveland; Harvey Cushing, Boston; George E. de Schweinitz, Philadelphia.

Term Expiring 1922: John M. T. Finney, Baltimore; James B. Eagleson, Seattle; Charles H. Mayo, Rochester; J. Bentley Squier, New York; Walter W. Chipman, Montreal.

HOSPITAL STANDARDIZATION

A Review of Progress Presented at the Clinical Congress of American College of Surgeons

GROUP consciousness is a phrase in frequent use today by the medical profession. It means team-work in the practice of medicine, team-work in the responsibility for the care of patients, and team-work in the operation of hospitals. Team-work in the operation of hospitals is especially a subject of new interest among doctors, and that subject was the single theme for papers and discussion all day October 24, during the meeting of the Clincial Congress of American College of Surgeons. The meeting occurred at the Waldorf-Astoria, New York, 3,040 Fellows of the College and other doctors and hospital superintendents being registered. The occasion was a review of what the College has accomplished in hospital standardization during the past year.

The program of the day consisted of a matter-of-fact statement of what the College has done and what it seeks to do in hospital standardization. These subjects were presented by Mr. John G. Bowman, director of the College. The practical application of the work of the College was than presented by a group of doctors and hospital superintendents. Dr. T. M. MacEachern, superintendent of the Vancouver General Hospital, described what hospital standardization meant at that institution. In a similar way Dr. George Gray Ward, Jr., chief surgeon, spoke for the Woman's Hospital, New York; Dr. Edward Thomas Dillon, surgeon-in-chief, for St. Vincent's Hospital, Los Angeles; and Mr. Frank E. Chapman, superintendent, for Mt. Sinai Hospital, Cleveland. Charles B. Moulinier, S.J., president of the Catholic Hospital Association, told of the progress of the Catholic hospitals and of their co-operation in the program of the C llege.

Dr. William J. Mayo, president of the College, presided at the morning session. Dr. Albert J. Ochsner presided at the afternoon session. In an introductory talk Dr. Mayo said in part:

SERVICE FOR THE PATIENT

"I think this hospital standardization has a possibility of good that is not recognized even by those who are engaged in the hospital work itself.

"Now, let us bear in mind all of the time that the doctor and the hospital exist for the benefit of the patient. A good many of us, I believe, have had a wrong idea. Some of us and some of the hospitals have felt that the College endeavors to force upon us some sort of a set standard. I know that there is no such intention on the part of the College. Our aim is merely that with whole-hearted co-operation with the hospitals we may think straight and in some measure give speed to the progress which we all desire.

"Let me say again that the hospital exists for the patient and not for the convenience of doctors. So long as we concede that doctors and the hospitals exist for the patients and that all of our efforts are made for the welfare of patients, we are on ground that is fundamental. We are on ground upon which we can get together and from which we can make progress.

"We must remember that if the patient is to receive what he has a right to receive, the hospital must furnish certain other things besides an opportunity for the doctor to work. Records and laboratories are matters of very great importance. The doctor, and I would say especially the surgeon of the last generation, was not prone to keep very accurate records. He was accustomed to do things in an individualistic way which will not be tolerated in the next generation. We must be tolerant with the doctor of this type and teach him the value of records to himself as well as to the patient. To the hospital, however, it is absolutely essential to have accurate records, for otherwise how can the hospital give an accounting of its service?

"We hear objection sometimes to complete hospital records for private patients. I do not attach much value to these objections. We have had such records in our hospital for over thirty years and there never has been a time when anything has come up that was at all unpleasant about these records. The poor have had records because, let us say, they could not help it; the rich and the middle class are just as deserving as the poor and they haven't the records. It goes without saying, however, that a hospital must safeguard its records in a manner about which there can be no question."

THE MINIMUM STANDARD

To understand hospital standardization, as devised by the College, and its meaning among hospitals, the first essential is to understand the minimum standard of the College. In this connection Mr. Bowman said:

"There is a wide, wide range of conditions in this country and in Canada to which hospitals must adjust themselves. No hospital, as the perfect model to meet all these conditions, has yet appeared. And yet, among all of these conditions, are there not a few details which we can all accept as essential to success in the care of the sick and injured?

"For more than two years the American College of Surgeons, by studying hospital conditions as they are in the field, endeavored to find these essentials. If now we are to make headway in an orderly fashion, it seems advisable that we agree upon some definite starting point or minimum standard. This standard must be practicable and workable. It must be within the reach of the fifty bed hospital and of the thousand bed hospital. It must grow out of the common purposes which we all hold for ourselves, the care of the sick and injured, the education of the medical profession, medical research, and the education of the public in matters of health and hygiene

"After more than two years of work, the minimum standard seemed gradually to find a sort of automatic expression among us. That standard is not the thought of a single mind. It is an expression which grew out of straight thinking among the clearest minds in medical and hospital work on this continent. Its fulfilment costs effort rather than money It safeguards the care of the patient admitted to the hospital by insistence upon competence on the part of the doctor, by thorough study and writing of each case, and by checking up at least once each month of the clinical service of the hospital. It fixes responsibility throughout the hospital. It calls for the 'production sheets' of the hospital. It encourages and even compels clinical research. It defines the minimum of service to the patient, upon which, beyond all debate, we are agreed.

"During the past year staff members of the College have carried personally this minimum standard to about 671 hospitals of 100 beds or more. They have endeavored to explain more vividly than is possible by letter or circular the meaning of this minimum standard. They have endeavored to find out, if the standard is not really what we want it to be, wherein it fails. The reception on the part of the hospital of these visitors has been a constant inspiration to increased effort.

"The minimum standard of the College is familiar to most of you, but let me briefly state it again:

"1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is 'open' or 'closed,' nor need it affect the various existing types of staff organization. The word *staff* is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the 'regular staff,' the 'visiting staff,' and the 'associate staff.'

"2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

"3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, and policies specifically provide:

"a. That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.)

"b. That the staff review and analyze at regular intervals the clinical experience of the staff in the various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analyses.

"4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in an emergency, which includes the personal history; the physical examination, with clinical, pathological, and X-ray findings when indicated; the working diagnosis; the treatment, medical and surgical; the medical progress; the condition on discharge with final diagnosis; and, in case of death, the autopsy findings when available

"5. That clinical laboratory facilities be available for the study, diagnoses, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluoroscopic service in charge of trained technicians."

"Some figures now may be of interest to you which indicate how far we fall below a simple standard of efficiency. Out of the 671 general hospitals of 100 or more beds in the United States and Canada, 264 hold regular staff meetings with the idea of finding out where their failures are and how they may prevent the recurrence of those same failures. In this group of 671 hospitals, less than half, or to be exact in 301 hospitals, the patients are treated after a physical examination is made and recorded. In the other hospitals of the group, while doubtless the illness of most of the patients is studied, the hospitals themselves have no evidence of such study. As I have asked of you on various occasions before, can a hospital which apparently assumes no responsibility for the care of its patients ask the good will and the confidence and support of its community? Out of the entire group, 198 of the hospitals fulfill the minimum standard as just stated.

"The purpose of the College in its work is to be constructive and not destructive, to encourage and not to discourage. It is our purpose, at the earliest date which all of us working together on this problem may consider right, to publish a list of the hospitals which fulfill the minimum standard. Do you believe it will be wise today to publish a list of the 198 hospitals? One year ago 89 hospitals out of this 671 met this standard. My belief is that one year hence more than 400, possibly 500, of the hospitals will meet this standard. They will then meet this standard, not because any one urged them to do so, but because they, themselves, believe that it is not only right but essential that they should do so. Would it not be the wiser procedure to wait for another twelve months before publishing a list, and in the meantime, in an orderly manner to review the data again with each of the 671 hospitals?

"It seems also that the time has come in which the hospitals of less than 100 beds may now advantageously be 'measured' by this standard. Our program for the coming year, still somewhat tentative, is to include in our survey the hospitals of from 50 to 100 beds as well as the hospitals of 100 beds or more."

On the practical application of the minimum standard to the hospital, Mr. Bowman said further:

"If the trustees of the hospital are responsible that every patient, free or pay, in the hospital receives the best care known to the staff, then they must at frequent intervals be in possession of the facts as to the care received by the patients in the hospital. The trustees must know, for example, if unnecessary surgical operations are performed in the hospital; or if incompetent surgical operations are performed; or if lax, lazy, or incomplete diagnoses are made. If infections occur, they must know, as nearly as may be, the cause of the infection, and make every reasonable effort to remove the cause. If the time of the patient is wasted between his admission to the hospital and the proper study, diagnosis, and treatment of his illness, again the trustees must know the facts and take action promptly to prevent further waste of this kind. Too frequently hospital trustees consider that their duties end with the management of the financial affairs of the hospital.

"How are the trustees to know about their hospitals? Certainly the answer rests with you, the medical profession. It rests chiefly in regular scientific analyses by yourselves of your clinical service. In order to make more clear what such analyses may be, let me cite the clinical record of two series of 100 operations for chronic appendicitis.

	In Hospital No. 1	In Hospital No. 2
Complete physical examination, including blood count	100	14
Number of consultations held	41	2
Working diagnoses recorded in advance of operation	100	None
Progress notes recorded by doctor	100	None
Infections following operation	3	12
Incorrect diagnoses	4	14
Number of patients relieved	94	77
Number patients died	2	9

"The analysis of the cases treated in Hospital No. 1 shows that a complete physical examination was made and recorded for each patient; that in order to clear away doubt as to the diagnoses, consultations were held in 41 cases; that the working diagnoses in these cases were, then, in fairness to the patients, recorded in the permanent records of the hospital; that, after the operations, the physicians or surgeons in charge of each case made or signed daily a statement of the progress of the patient; that infections developed in 3 cases; that the number of incorrect diagnoses was 4; that the number of patients apparently relieved of their illness was 94; and that 2 of the patients died following operation. This record is a credit to the staff of the hospital.

"The corresponding data are now given for a similar series of cases in Hospital No. 2. The data as here presented could not occur in a hospital which meets the Minimum Standard. In a hospital which meets the Minimum Standard, for example, it is not possible that any patient,

except in an emergency, will go to operation in advance of a complete physical examination. But in Hospital No. 2, 86 of the patients were operated upon without a complete physical examination. They were operated upon, it seems, after guess-diagnoses rather than after scientific diagnoses with consultations when indicated.

"Considering the record of Hospital No. 2, is there anything unreasonable in asking that the staff meet at least once each month; that it analyze the facts of its clinical work; that it determine, as nearly as may be, the causes of its failures; and that, demanding the support of the trustees, it endeavor to remove these causes? For example, 12 of the cases developed infection. Whose cases were these? What is the nature of the infection as indicated by laboratory analysis? Were the cases operated upon in rooms where pus cases had also recently been operated upon? Is the sterilization in connection with the operating room effective? When was it last tested and how? What technique is carried out in connection with surgical operations? If the staff of Hospital No. 2 would in dead earnest ask such questions as these each month, the percentage of infections would undoubtedly decrease. If the staff-review were really penetrating, the percentage of deaths would undoubtedly decrease. Matters, too, of incompetence, when the facts indicated incompetence, would be dealt with in no uncertain manner. The staff would become restricted. The doctor scarcely exists who, if incompetent and if his incompetence is brought to light at frequent intervals, will not endeavor promptly either to perfect his training or retire from membership on the staff. The same principle is true with regard to character and professional ethics. Can any staff rest content with less than its maximum effort at all times to perfect the service of its hospital?"

CO-OPERATION OF CATHOLIC HOSPITALS

Charles B. Moulinier, S.J., said:

"We cannot dwell on fundamentals too often or too much in order to bring about best results. We must think in terms of staff organization, case records, and adequate laboratory service. These things mean hospital standardization. Everybody who knows anything about modern medicine knows that it has passed out from the individualistic practice of the past into the group practice of the present. . . .

"The standardization of hospitals is nothing more than the bringing about of a similar situation among the hospitals. Team-work and co-operation on the part of each worker in the hospital is essential; and if we are to have team-work and co-operation, we must have organization. Organization is the cornerstone of the whole edifice. If there isn't organization among the doctors—real, genuine, active organization, including their minds and their hearts and their wills—if it isn't so strong as to dominate selfishness and put it in the background, as to make them forget personal interests and personal ambition in view of the needs of the patient, then the organization means nothing.

"But organization must not end with the staff; it must include the managing personnel, whatever that be—board of trustees, superintendents, Sisters. They must be organized. They must know what they are for, what they are doing, what the whole purpose of the hospital is; and they must from day to day be imbued with the spirit that it is only by team-work in their hospital that the patient can get what he has a God-given right to.

"Organization of that kind is bound to result in records—full records, complete records, genuine, true, scientific records, that are the pledge to the patient of what the hospital has done for him or her; that are the guarantee to the public of what is being done in the hospital; that are the testimony to the medical profession that the doctors, managers, and nurses are doing their professional duty to the sick. You know better than I do that all growth in medical knowledge comes out of the records; that it does not spring directly out of the mere thinking of medical men, the mere working in the laboratory, the mere cure of patients. It springs from orderly, accurate records. You know that the textbooks are made up from records of the past; that the medicine of the moment is in the records that are being formed, and that this knowledge later finds its way into the literature, into the journals and the books with which your shelves are so filled.

"Records are absolutely necessary. Any hospital that does not keep records or any medical man who does not keep records is derelict in duty to the patient, to the public, and to the profession."

Father Moulinier emphasized also the importance of clinical laboratory service. Then in closing he said:

"I am just going to say in closing that I pledge to the American College of Surgeons, with all the official capacity I have, that the Catholic Hospital Association, with whatever force and power it has, that the hierarchy of the Catholic Church, that the clergy of the Catholic Church, and that the great body of twenty or thirty thousand

Sisters working in Catholic hospitals, are going to co-operate with the College to the highest point. Just be patient a little here or there and you will be satisfied, not to say delighted, with the kind of co-operation you will get from the Sisterhoods and from all this Catholic body."

ACTION OF CANADIAN HOSPITALS

In speaking of hospital standardization at the Vancouver General Hospital, Dr. T. M. MacEachern, the superintendent, illustrated his subject with lantern slides. The slides illustrated both the forms of keeping records in the hospital and of analyzing these records by the staff. A point of considerable interest was the employment by the hospital of a director of medical records who, with an organization under him, is responsible for the carrying out of the rules and regulations, which the staff has recommended and which the board of trustees has approved, governing the care of patients in the hospital. The director of medical records follows in a kindly and yet critical way the progress of each patient in the hospital. Each month he prepares an analysis of the work done in all departments of the hospital, and this analysis is presented to the staff for its consideration. Dr. MacEachern reported enthusiastically for the success of the plan.

At the beginning of his talk Dr. MacEachern said:

"I bring to you today, I trust, an encouraging report from the Vancouver General Hospital, and I bring also gratitude and encouragement from the Province of British Columbia and from Western Canada. On my way through Alberta and Saskatchewan I found that the hospitals were actively molding their policies along the lines of hospital standardization which we have just heard here outlined. That plan has come to us at the psychological moment. It has come at a time when reconstruction among our hospitals is uppermost in our minds, and at a time when all of our people are enthusiastic to create for themselves the right sort of institutions through which they maintain their right to be well. The College has helped us enormously as hospital workers. We are not only all pledged to hospital standardization, but we are also now engaged in carrying out the program of hospital standardization in a real and practical fashion."

AT THE WOMAN'S HOSPITAL, NEW YORK

Marked interest centered in the work at The Woman's Hospital, New York, as directed by Dr. George Gray Ward, Jr., with regard to staff meetings. Dr. Ward said:

"A staff conference is held once a week throughout nine months of the year which the entire hospital staff is always expected to attend. These conferences last about one hour and the medical public is welcome. The order of procedure is as follows:

"*Presentation by the pathologists* of the pathological material of interest which has been obtained during the week; gross and microscopical specimens together with brief talks on the pathology.

"*The casualties of the service* are next called for. Each attending surgeon must report any deaths, infections, or complications occuring during the week in patients under his care, and an endeavor is made to locate the cause. The details as shown by the case histories, and the testimony of those concerned are carefully analyzed in order that it may be determined, as far as possible, whether the fault lay with the doctor, the patient, the disease, or the hospital organization or equipment.

"*A report on the analysis* of the 'follow-up' clinic of one of the attending surgeons is next made. Each of the four attending surgeons have such a clinic once a week which they must attend in person, and once in four weeks they are required to make an analysis of the results of the cases they have seen since their previous report. This analysis must show the total number of cases seen in the clinic and the number of those which have previously been reported. The remainder which are to be reported are classified according to the results as successful, partially successful, and failures. The acid test for the determination of the result is whether the patient has been relieved of the symptoms for which she sought relief, and not whether the operative result is satisfactory to the surgeon. The successful cases are disregarded, while each partially successful case and failure must be analyzed in detail and the reasons given for the classification. A free discussion is encouraged in order that the operating surgeon may have every opportunity to defend his position. Cases that may have been previously reported as successful and which may later become partially successful, or failures, must be subsequently reported with their revised classification.

"*A report of a few cases* of special interest is next made by some of the attending surgeons, in turn. Thus an opportunity is given to report on case histories or to present patients who have been treated with successful results. Frequently a case presenting difficulties in diagnosis or treatment is shown, and the advice of the conference is sought. Once each month the junior attending surgeons are

required, in turn, to give a brief summary of the recent gynecological and obstetrical literature, or to give a report on any hospital or operative clinic they may visit. Problems relating to technique, operating rooms, sterilizing rooms, wards, etc., are brought forward for general discussion when necessary, in order that the various points of view may be obtained. A stenographer is present during the conferences who makes complete stenographic reports of the proceedings, which are kept on file in the office of the chief surgeon for further study."

AT ST. VINCENT'S HOSPITAL, LOS ANGELES

Dr. Edward T. Dillon, surgeon-in-chief at St. Vincent's Hospital, Los Angeles, thus described what standardization means to his hospital:

"For many years St. Vincent's Hospital was conducted as a general open-staff hospital. It assumed no direction in methods of examination or treatment employed. It executed orders only of general care and nursing.

"However, the idea of bettering this situation grew and developed. Then, to accomplish a reform, it became necessary to subordinate the individual, to overturn a routine of years, to co-ordinate the efforts of the hospital and of the physician, to eliminate those of the profession who failed to meet the demands and responsibilities of a more complex organization, to do the best for humanity regardless of the personal equation.

"Briefly, we required these things: Signed records, including the personal history, physical examination, routine blood and urine examinations, and recorded blood pressure in all cases before any treatment whatsoever is instituted. There are no exceptions to this rule. Clinical diagnosis must be supported by laboratory findings. Patients may not be taken to the operating room unless accompanied by these records together with a written pre-operative diagnosis. All tissue removed remains in the possession of the hospital, and, as a routine, is sent to the laboratory for analysis and report. All records, together with the summary, final result, and follow-up card remain in and are the property of the hospital. Records are inspected, and there must be the proper co-ordination between recorded findings, diagnosis, and proposed treatment. This applies particularly to surgical cases. Post-operative complications, delayed or unsatisfactory results, are not considered a matter of individual responsibility They are investigated by the authoritative co-operation of the staff and the hospital administration, and the cause determined if possible. Regular meetings of the staff afford opportunity for discussion of problems of procedures connected with the hospital.

"The hospital does not now hesitate to refuse admission to such patients as have incompetent medical or surgical advisors. The question of their refusal or admission is no longer a personal or individual matter, but merely the meeting of certain well-founded regulations.

"These things have not been accomplished without friction and criticism. But we have zealously endeavored to establish the merit of what we stand for. Already, discontent with and antagonism to the new order have practically disappeared. The benefits derived from the adopted measures of standardization have come to all patrons of St. Vincent's Hospital both within and without the profession. The careless or indifferent practitioner has benefited by examples of conscientious work and its fruitfulness; the incompetent practitioner has been excluded from the privileges of practice in the hospital. Patients have shown their appreciation of this great work through an increased waiting list for entrance to the hospital. The community at large has realized in a short space of time that the standardized hospital offers a superior service. Its appreciation has also been shown by the demand for a larger institution and by offers of financial assistance to carry the work still further."

AT MT. SINAI, CLEVELAND

Mr. Frank E. Chapman described in detail the application of standardization principles at the Mt. Sinai Hospital, Cleveland, where he is the superintendent. In drawing a parallel between a well-run manufacturing organization and the routine of a well-run hospital, he said:

"In the manufacturing plant, we see first the administrative head, represented by either an individual or by a governing board entrusted with matters of finance, matters of external policy, etc. Next we see a group of department heads, representing what is commonly termed the 'shop council.' One of the functions of the administrative head is to create an 'esprit de corps' in this council that will tend to produce a maximum of efficiency throughout the shop. This shop council, as a rule, is responsible for the operation of the plant, for the formulation of internal policies, and is held directly responsible for the output. It is incumbent upon this body to develop such efficiency methods as are necessary to produce a maximum result. It is a general practice that this council formulate for itself a

system of records that will show from time to time the performance of the various units of the shop. These records are compiled in the accounting department, and show at a glance the relative performance of the shop as a whole, the production, the cost of production, and such other information as is necessary for a study of performance In addition thereto, and considered as a legitimate part of the cost of manufacture, is maintained a laboratory for testing the product of the plant, also for developing new procedures and new methods of manufacture. These compiled statistics, both from the shop and from the laboratory, are used as a basis for passing judgment upon the efficiency of the shop as a whole.

"Let us now see how close a comparison can be drawn with a hospital organization.

"First, we have the administrative head, functioning identically as does the administrative head of the manufacturing plant. Next, we have the shop council, or in other words, the medical staff. No institution, no matter what its physical development, can be of much value without an 'esprit de corps' in its staff that can surmount the obstacles that are bound to develop. The administrative head must do everything possible to create this spirit by furnishing to the organization the facilities necessary for an efficient performance of its duties. It is equally essential that this group be cognizant of the aims of the administration, and that in turn the administration know the aims of the staff, that there may be a co-ordinated effort toward the attainment of a goal.

"You should not expect a busy member of the attending staff to be responsible for the actual taking of records, just as you should not expect the operator of a given piece of machinery in a plant to be responsible for the recording of the performance of that unit. If you are to get proper case records, or if you are to get proper production records, it is essential that the administration furnish, through the council, the machinery to make this record. At Mt. Sinai, we meet the need of the staff by providing dictating machines.

"A production record in itself is of little value unless it is compiled for comparative purposes. Equally true is the statement that case records are of little value if they are written only to be filed. It is here that the statistician, or cost clerk, becomes of use. But please do not understand that this statistician is in any way a judge of the performance of the plant or of the hospital. It is merely his or her duty to compile the results as demonstrated by the production records, these results to be passed upon by the shop council. I feel that this is a very important point to make, that the staff itself must be the judge of its own performance, keeping in mind at all times, however, that it is definitely a part of the duty of the administrator to know that the results developed are carefully studied by the staff, and that a conscientious endeavor is made to improve conditions.

"It is almost inconceivable that a manufacturing plant would operate without these cost and production records. Is it therefore not equally essential that a hospital, that deals in a commodity much more precious than one of dollars and cents, be as zealous in its performance and apply every known means to the development of an efficient end-result?"

SURGERY, GYNECOLOGY AND OBSTETRICS

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PLASTIC SURGERY OF FACIAL BURNS[1]

BY MAJOR H. D. GILLIES, R.A.M.C., SIDCUP, ENGLAND

THE object of this paper is to place before the surgical profession the results of various plastic methods employed by the author for the relief of the distressing deformities and disabilities arising as the result of contractions following severe facial burns. While feeling that the methods, drastic as some of them are, are justified by the relief of symptoms, and by the very great amelioration of the disfigurement, the author must admit that, in the severest cases, he has seen as yet no perfect result. Parts of the restoration, say the eyelids, cheek or nose, may be as perfect as can be, but other parts will be defective and mar the total effect.

The author hopes that by criticism and development of his methods, others may advance the plastic treatment of these terrible deformities to a stage in which complete success will be the average prognosis.

GENERAL CHARACTERS

The character and extent of burn disfigurement vary directly with the direction of intensity and duration of the heat applied. The acid burn which splashes the face may be described as a collection of deep burns of small areas, joined by less severely affected, and even normal, patches of skin. Its duration of application is long but localized.

The airman's burn and the cordite burn directly follow the stated formula, but their appearance is greatly different owing to the differences in clothing. The head gear usually worn by the airman and by the gunner limits the extent of the burn. The airman is protected by his helmet and his scarf. The soldier gunner often has his tunic and cap on at the time of an explosion, while the sailor gunner has usually none of these protections.

All classes of flame burns show deformity of the eyelids in the form of a greater or less degree of cicatricial ectropion. It would appear that the eyelid skin, closed tightly to protect the vision, is the most vulnerable portion of the face. Certainly many cases have healed clear of all serious deformity except that a degree of ectropion of the lids remains. Coupled with a general pitting and paleness of the burned area this ectropion forms the first deformity to appear. With increasing severity other deformities appear; the whole facial skin is burned off down to the muscular layer leaving a ghastly scar, prominent points receiving more punishment than do the hollows; the skin of the nose is usually destroyed, while in the severest cases the bony framework of the nose covered by a scar, alone remains, the mucocartilaginous parts of the tip below the pyriform opening being involved in the destruction. Increasing destruction of the eyelids and of the ectropion occurs, until in the severest cases all layers of the lid are removed by the fire and the very eye burned out.

This extreme result has occurred in only one of the author's series of cases, while in one other the sight was permanently destroyed

[1]Read before the Clinical Congress of American College of Surgeons, New York City, October 20-24, 1919.

Fig. 1 (at left). Very severe airman's burn.
Fig. 2. Large Wolfe graft from buttock to right cheek, fourth day.

except for perception of light. Corneal ulcers are common. The eyebrows, forehead, and malar regions are vulnerable points; when the fire is sufficient to destroy the nose, the upper lip is burned and becomes ectopic, while usually the lower lip is similarly affected. Two types of contracture occur with the mouth. In one the angles are drawn backward in a permanent grin showing the teeth; in the other a ring of scar tissue closes the mouth to a small unyielding circle admitting only the tip of the thumb. In addition to the ectropion already described, a similar type of contracture occurs around the palpebral fissure.

A dense band of scar tissue sometimes appears at the inner canthus region, uniting the upper to the lower lid, and to the side of the nose, thus protecting the globe from excessive exposure. This epicanthus band is often so deep that it almost obliterates the normal hollow between bridge of nose and eye. When it is excised the true ectropion of the lids becomes evident, showing that a potential ectropion existed but was masked by this unyielding epicanthus band.

The skin over the prominence of the mandible is usually caught by the fire and tends to heal with marked keloidal scars (Fig. 16). When the neck is burned it shows either isolated keloids or vertical bands perverting extension of the head.

The pinna is one of the most vulnerable points when not protected, the helix alone covered by a poor quality of regenerated skin being left in the worst cases.

VARIETIES DUE TO PROTECTION

The *airman's burn* presents a clear clinical picture owing to the leather helmet, cheek, and chin straps, and the muffled neck; the area of deformity is strictly limited within this mask. A clear-cut line of demarcation follows closely where the helmet and cheek straps have been. The neck and chin escape except where metal trickles touch the neck. Here keloids are seen. The ears are never attacked.

The *cordite burn* shows no special line of demarcation. The ears are always burned, while the area of the neck involved depends on the clothes the victim was wearing at the time. Thus, a sailor case showed the largest extent, as during action he had no protection above the clavicle.

Acid burns are limited to the area splashed.

Household burns and burns during epileptic fits depend for their extent and severity on obvious local factors. An epileptic will lie with part of his face on a red hot bar until the area in contact is very deeply involved.

In the two main varieties of burns from flame the hands are always burned as they are instinctively applied to the face with the dorsal surface to the flame. It follows that contractures of the extensor mechanism is frequently met with (Figs. 4 to 9).

TREATMENT

Early. The author has no data on which to hazard an opinion as to the best early treatment, nor as to the origin of true keloid and of excessive scar-tissue formation.

Intermediate. In regard to the intermediate stage when the burn is healed and the scar active, measures to reduce fibrosis are indicated. Good results appear to have accrued in some cases from diathermy, ionization, massage, and protection by a greasy mask.

The filtered X-ray and its more potent colleague, radium, can reduce scar tissue to a minimum, but in so doing so much radiation penetrates the deeper structures causing atrophic changes that the advisability of its full use in a case that obviously will require major surgical repair, is extremely doubtful, as its use may seriously militate against surgical success. The balance in favor of success is so lightly held in this class of repair that such preliminary treatment producing avascularity, cannot but be viewed askance. When surgical treatment is not in view, then the use of rays or radium is indicated where the scar tissue is excessive. An exception to this procedure appears advisable in isolated keloidal scars, which may be excised locally. Here it is the author's practice to subject the scar to rays before and after excision, since, in the absence of any necessity for large flap or graft operations, the question of tissue vitality does not arise.

Final or plastic. The best time to commence the plastic treatment proper would appear to be about the time the scar has ceased contracting, a point not always determinable, often not occurring for a year or more.

At any time during this stage if there is excessive exposure of the cornea from ectropion, corneal ulceration may develop and may necessitate an emergency operation to give protection. Flaps of scar tissue and various grafts have been utilized to cope with the condition, but as a rule they are temporary measures and form no part of the final make up.

The general *plan of reconstruction* must now be formulated, the first essential of which is an accurate determination of the tissue that has been lost. In this connection allowance must be made for the release of the normal tissues occurring when the binding scar has been excised. Except as regards the nose and ear, this resolves itself usually into an estimation of the loss of skin covering only, neither the mucous membrane cavities nor bony framework being involved. As far as it is possible to generalize the procedure adopted in a series of cases, each of which has had to be treated individually, the author's practice is as follows:

A male patient requiring complete facial replacement presents himself for treatment.

1. The forehead is replaced by a Wolfe graft.

2. The eyebrows are grafted by taking a strip of the scalp from over the mastoid region. The strip has to be so deep as to include the hair follicles. The strip from the left mastoid goes to the left eyebrow, and the right to the right in order that the hairs should grow in the right direction (Fig. 33).

3. Movable eyelids are provided by the author's "epithelial outlay" operation, which is an adaptation of the Esser inlay. This method of skin grafting is usually applied also to the inner canthus region.

4. The nose is renovated by a Wolfe graft. To complete the lining and support of the new tip and alæ destroyed, parts of the scar tissue overlying the margins of the defect are cut into suitable flaps and inserted so that their epithelial surface forms the lining of the vestibule. The flap is stiff enough with its cartilaginous remains and fibrous tissue to form adequate support for the new tip and alæ. Remaining scar tissue is excised and the Wolfe graft applied over the whole raw area. Instead of a graft its place is preferably taken

Fig. 3. Abdominal flap to dorsum of burned hand.

by a *flap*, when such is available. The skin of the flap comes from the chest or neck, and is usually part of a tubed pedicle which is being used for the remaining replacement. Flap skin is better in appearance than successful Wolfe graft skin, and lends itself better to shaping and retouching operations.

5. The upper lip is revived by a whole depth hair-bearing graft from the scalp region, similar to the eyebrows, care being taken to secure correct line of hair growth.

6. The cheek, chin, and lower lip replacement is made by transferring in stages a large flap of skin from the neck and chest. Both sides of the face may be attacked simultaneously or separately, according to the constitution of the patient, or to local considerations. The line of replacement aimed at commences at the vermilion border of the lower lip, out to the angle of the mouth, up the nasolabial fold and side of nose, along the infra-orbital ridge to link up with the existing grafts, across malar and zygoma, down in front of the ear, and along the border of the mandible, according to the lateral and inferior limits of the scar.

When available in sufficient size, the author's retro-auricular flap gives the best results in cheek replacement on account of the affinity of this skin to that of the face. In Figure 14 the perfectly natural character of such a new cheek may be observed. No chest skin, even after bronzing in the sun, has as yet given a natural looking face skin, as it is inclined to be dry, pale, and lacking in surface vessels.

These large flaps, especially the tubed pedicle ones, involve a multiplicity of operations which, coupled with the indicated intervals of convalescence, stretch over a period of one to two years. To reduce length of treatment and multiplicity of operations, the author is now tentatively employing larger and larger Wolfe grafts, even to movable parts such as the cheek. Over the firm parts, such as the forehead and nose, uniformly good results are being obtained with these large grafts, but as yet in the cheek and chin cases the outcome is problematical. One such large Wolfe graft replacing the right cheek is illustrated (Figs. 1 and 2). Parts of this graft broke down and failed to perish as a Wolfe graft. More than 60 per cent of it, however, took as if it were flap skin, and the remaining portions epithelized over as if a Thiersch graft had been applied. A final good result is now assured, although the case is incomplete and many months of treatment have been saved.

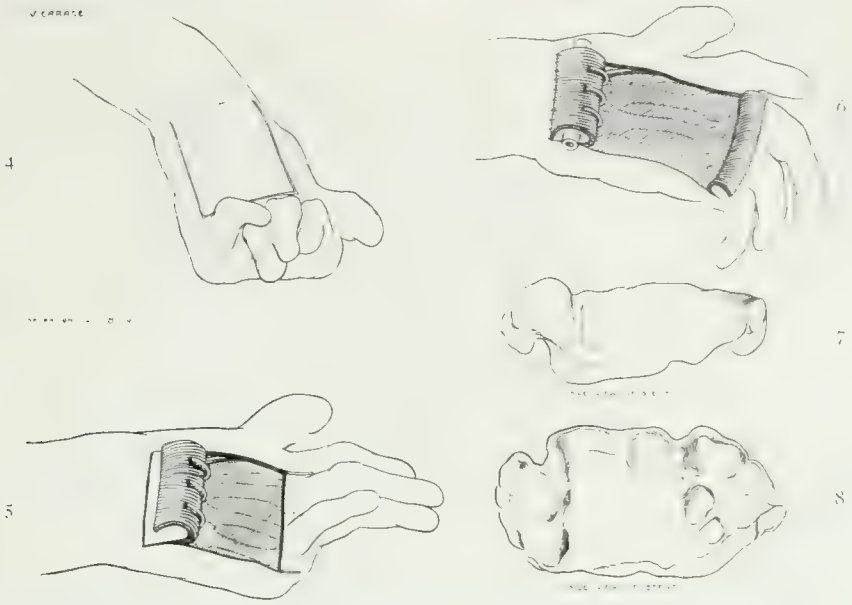
7. The ear is a separate problem, usually neglected in severe burns on account of the length of time taken in doing the more important facial repair. The ordinary principles apply, viz.: two layers of skin enclosing shaped cartilage are grafted by stages into the required position.

8. The hands. Scar tissue should be replaced by healthy skin in all cases, transferred there by the abdominal method or by the author's tubed pedicle method, or by Thiersch grafting. The shortened extension tendons may be lengthened by a kinematic operation coupled with grafting as indicated in the illustrations and diagrams (Figs. 4 to 9).

METHODS EMPLOYED AND THEIR TECHNIQUE: FLAPS, WOLFE GRAFTS, THIERSCH GRAFTS

Flaps. Two areas from which to draw the necessary skin for replacement by flaps present themselves: (1) from beneath the mandible and behind the ear, and (2) from the neck-chest region.

1. The special advantages of the post-auricular flap have been noted above. It is not available when there is scarring in the



Figs. 4 and 5. Incision and flap with extensor tendons for kinematization of three inner digits.

Fig. 6. Epithelial tube completed. Metacarpophalangeal joints opened to release the three fingers.

Figs. 7 and 8. The impression of the whole raw area taken in dental compound or "stent," on the under surface of which the Thiersch grafts are applied. Drawn by S. Hornswick.

carotid triangle area of the neck, and is not wide enough in those cases in which there is a narrow area of non-hairy skin between the pinna and the scalp. The author widens it by turning the pinna forward and reflecting the skin off the posterior surface as part of the flap (Figs. 10, 11, 12). It is further widened by including scalp proper. This backward extension, however, is dangerous if extensive, as it is found that the scalp portion declines association with the thin skin over the mastoid. There would appear to be a weak anastomosis between the vessels of the two areas, though each is richly endowed from its own supply. The incisions necessary to make such a flap are sufficiently clearly designated in the diagram to require no special description (for examples see Figs. 13 and 14).

2. Skin from the neck-chest region may be transported to the face in two main ways: (a) direct with the pedicle embedded as part of the flap, or (b) by stages, the pedicle being tubed.

a. The two methods are combined with advantage in some cases, the replacement being direct while the pedicles are tubed at the time of operation (Fig. 27).

The direct method has the value of shortening the process, but is more severe on the patient generally, and on the flap in particular. In Figure 15, the whole of the right cheek of

Fig. 9. Early result. Note perfect epithelization of area, including the articular surfaces, improved position of digits, appliance ready for attachment of artificial tendons so that dorsiflexion may be possible.

Figs. 10, 11, and 12. The author's po.tauricular flap for cheek replacement. Drawn by S. Hornswick.

the patient has been replaced by the large ascending neck-chest flap now seen in position. This flap gave much anxiety and appeared to slough in many places. The final result, however, justifies the severity of the procedure. The base of such flaps has to be very wide.

b. The *tubed pedicle* method is one that was propounded by the author in September, 1917, when he was first confronted with the most severe type of facial burn. Its primary object was to protect the pedicle from infection and exposure during the healing of the flap proper on the face. It then became apparent that such a tubed pedicle made in a preliminary stage would develop a richer vascular communication to the flap proper. This expectation was realized and it became possible to reduce the width of the pedicle and its base (see Figure 22 in which the pedicles were tubed in the first instance and have narrow bases).

Speaking generally, the process is as follows: The base of the pedicle lies at the upper part of the neck, and is 2¼ to 3 inches in width. Two parallel cuts are now made down the neck, and over the clavicle. Here the area to be transferred to the face commences to be marked out, and of course varies with the type of reconstruction in hand. Where the area is very large it is indicated to attach two pedicles to it, one on each side of the neck, the flap proper being situated centrally (Fig. 22).

On one occasion the author designed four tubed pedicles to a very large flap; the whole procedure, however, was ill judged on account of the patient's general condition, and disaster befell both the flap itself and the patient.

In the first stage of an ordinary tubed pedicle, the area of neck skin outlined by the incisions described above, is raised by undercutting until it is quite free except for its upper base attachment, and for its lower or flap attachment. The two skin edges are now turned forward toward each other and toward the neck, adapted and sewed accurately together by continuous suture. The tube being made, the margins of the defect so caused are freely undercut until approximation can be effected beneath the pedicle (Figs. 16 to 20). Tension sutures are necessary to prevent breaking down of this wound. The author usually employs a deep near-far-far-near catgut suture together with button protected silkworm mattress sutures for this purpose (Fig. 16). Purchase from the periosteum of the clavicle is used to pull forward the posterior triangle of skin by catgut sutures, helping also thereby to obliterate an unpleasant hollow which develops just above the clavicle. Approximation is aided also by manipulation of the shoulder and head. When primary closure of the secondary wound is not obtained, Thiersch grafting is indicated.

When the next or second stage occurs (any time after three weeks) the flap proper is outlined and raised from the chest and grafted to the required area of the face. The secondary raw area is treated similarly to that of the neck.

Fig. 13.

Fig. 14.

Figs. 13 and 14. Airman's burn, very severe. Cheek replacement by postauricular flap.

It is to be recognized that in all cases of tubed pedicle, the blood supply to the tube after the first stage may be coming mainly through the chest or lower end. Hence it follows that in the second stage when this supply is cut off, sloughing troubles are to be met with. To circumvent this danger, the pedicle and its flap may be further prepared by undercutting the chest attachment by partly tubing the flap proper or by circumscribing the area of skin with a knife, some days prior to the second stage. The best basis of blood supply for the pedicle would appear to be those situated high in the neck in the submaxillary triangle where the anastomosis of the transversalis colli and suprascapular vessels come into play. In order to improve the vascularity at the base, the author has deliberately shifted the base of the pedicle to the submandibular in order

Fig. 15. Cordite burn. Right cheek replaced by neck-chest flap. Broad pedicle embedded.

to secure a richer flow of blood. This carried out in one case enabled the second stage to be successfully accomplished, when its success seemed in jeopardy owing to the fact that in the healing of the tube pedicle stage, trophic troubles made their appearance about the center of the pedicle. The principle of moving the base on to a more vascular area underlay in the first place the retro-auricular flap above described. It was first intended to act as the base of a tube pedicle running down the neck, but in the case in which it was used the flap was extended sufficiently to include the pinna and mastoid skin so as to effect a complete restoration.

In the third and subsequent stages in which the pedicle itself is swung up to the face on the new facial blood supply, in only one case has there been any deficiency of nutrition to the transplant.

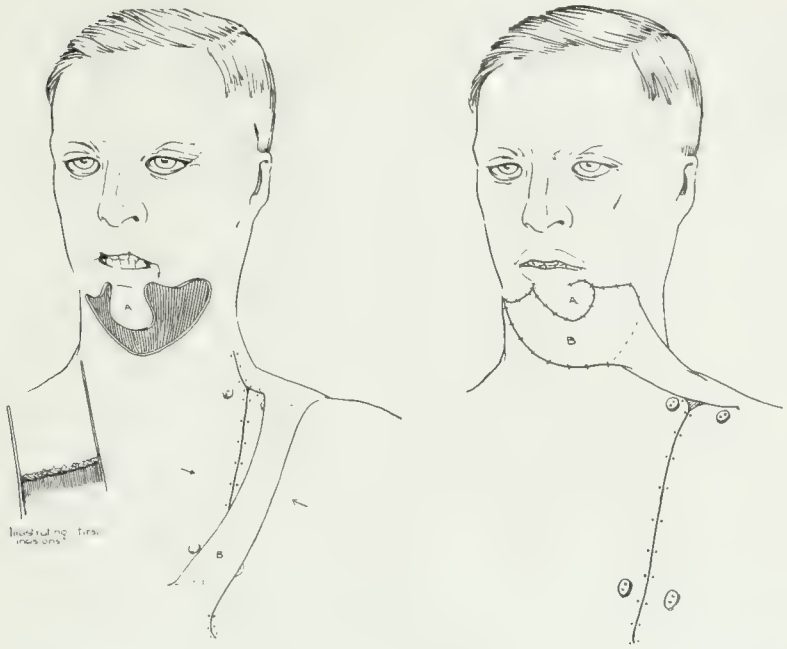
The third stage consists in the disposal of the pedicle. Two courses are usual. In one the pedicle is cut close to the face and replaced into the opened out wound of the neck (Figs. 21 to 25); in the other the pedicle is cut close to the neck attachment and swung up to the face (Fig. 20). It is usually long enough to cover a new nose or to make any portion of the face below the eyes. It stands kinking well, as it is found that the new blood supply into it, coming from the facial anastomosis, is better than its original neck supply. Further, if long enough it may be shifted a third or fourth time, using either end as its base of supply. Thus the author has made a nose out of the neck end of the pedicle, has cut it off after a due interval below the new nose, and has spread the balance out over the cheek. In another case with bilateral pedicles the left one was swung around to make a nose, while the right was spread out to make a cheek (Figs. 26 to 33).

In all cases of pedicle utilization, the part to be grafted has to be untubed and flattened out. This is easily effected, if no infection of the pedicle has ever occurred during its existence, by simple excision of the small scar where union of the edges has taken place, coupled with the removal of a central core of thickened tissue, which varies from a negligible quantity to quite a thick strand. If this core be not removed the skin of the pedicle will not flatten out satisfactorily.

In regard to shrinkage of the skin in the pedicle, very little would appear to occur where the final spreading out of the skin is made with adequate tension, equal to that which it possessed in the neck before interference. A small amount of skin is lost in the intubing process normally, more when infection occurs in the exceptional case.

(If it is desired to make a whole new lip, as in a gunshot injury, the pedicle is not opened out but grafted as such, so that a double epithelial surface results with a prominent edge and smooth contour.)

The author wishes to point out the value of the tubed pedicle principle in those cases of limb contractures from burns or other causes, in which it is a desideratum to graft large plaques of body skin over the scarred area. It has fascinating possibilities in the reconstruction of the penis and the breast, and when made in the reverse and covered by epithelial grafts may be utilized some day to convey food from the pharynx to the stomach. Manipulation would have to take the place of the swallowing movements. Extensive œsophageal operations might thereby be facilitated or made practical.



Figs. 17 and 18. Diagrams of Stages 1 and 2. First stage (at left): Four inch parallel chest flap tubed. Complete closure by advancement. Second stage: excision of scar tissue for reception of lower extremity of flap *B*, Fig. 18. Flap *A* swung to left. Chest flap partly untubed and sewn into place. Drawn by Lieutenant A. Lindsay, A.A.M.C.

FIG. 16.

FIG. 19.

FIG. 20.

Fig. 16. A neck-chest tube pedicle which has been prepared for replacement of a keloid scar along the mandible. First stage.

Fig. 19. Early result, third stage.

Fig. 20. Later result, third stage, showing improvement in junction line with face.

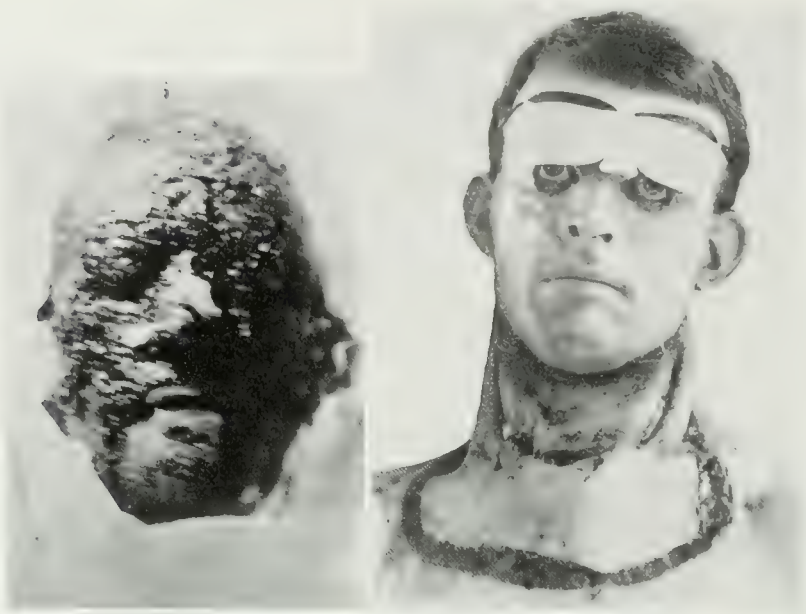


Fig. 21 (at left). Cordite burn, soon after injury in Battle of Jutland.
Fig. 22. Healed with very severe ectropion and upper facial burn. Bilateral tube pedicles to chest flap, first stage.

The Wolfe graft. The present position, as far as the author knows, of this method of supplying skin to the face shows promise of a more extensive field of usefulness. When successful, the character of the new skin would not appear to be as cosmetic as flaps of skin. The latter is transplanted with its glandular element intact, while the typical

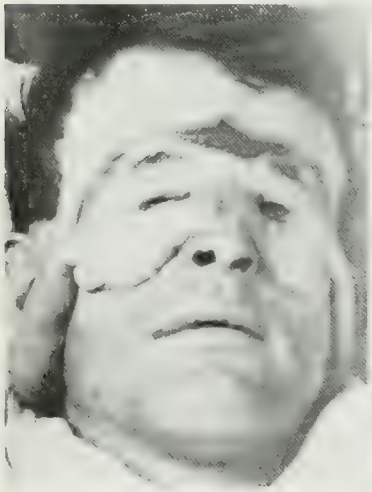


Fig. 23.

Fig. 24.

Fig. 25.

Fig. 23. Second stage, pedicles and flap in position.
Fig. 24. Third stage, pedicles opened and returned to neck. Note development of facial expression lines, a free blush was present in this graft in the third week.

Fig. 25. Six months after first operation. Note grafts to eyelids and adaptation of flap to its new position. Artificial eyebrows.

Fig. 26 (at left). Total facial cordite burn. Battle of Jutland.
Fig. 27. Large chest flap applied to face with two tube pedicles. The skin over the nose has sloughed. The left pedicle has been divided.

Wolfe skin undergoes considerable mutilation on its deep surface during the process of its removal. At first the differences in the two transplanted skins bear out this proposition, but in the course of time become less marked. Skin, when taken either from the trunk or from an extremity, never really develops the characters of the facial covering, but critical sensation, pigmentation lines and even blushing are observed in such transplants. There remains an absence of bloom, a coldness of color, conditioned by a deficiency of glandular content, of pigment, and of superficial vascularity.

Successful Wolfe grafting may now be predicted when applied to such firm areas as

Fig. 28.

Fig. 29.

Fig. 30.

Fig. 28. Both pedicles divided. Note ectropion of eyelids.
Fig. 29. Method of converting the left pedicle into a nose. A suitable epithelial lining was provided for the new tip and alæ. Drawing by Prof. H. Tonks.
Fig. 30. Left pedicle swung to the nose.

Fig. 31.

Fig. 32.

Fig. 33.

Figs. 31 and 32. Final stages. The right pedicle has been spread out over the cheek. The new nose has been trimmed and supported by cartilage. Four new eyelids have been provided by an "outlay" operation. New eyebrows have been grafted.

Fig. 33. Illustrating functional cure of ectropion.

the forehead and nose. Skin edges must be accurately sutured. It would appear that tension of the grafted skin should be equal to that of the area from which it is removed. An exact tailor's fit should be aimed at, so that even tension exists throughout. It follows that to cut the graft larger than this "to allow for contraction" is a proposition obsolete both in theory and practice. The author is of the opinion that holding a flap or graft on tension is beneficial to its success by virtue of keeping open the tiny spaces through which anastomotic processes may occur and tissue fluids come and go.[1]

A case has already been mentioned in which the whole cheek was replaced by a large graft (Fig. 2). In another case the graft was a distinct failure, patches only of it persisting while the areas epithelized over. The deformity as a whole has not thereby been reduced. A flap operation is now indicated.

Pressure as well as tension is applied to a Wolfe graft so that the new skin is firmly pressed on to its new bed until adherence has taken place. Collections of blood and body fluids are thus prevented from collecting under the graft. *Application* of the pressure is secured without difficulty on the forehead. On the nose one method entails the use of a molded splint made of dental modelling composition, which is in its turn held in place by strapping by a spectacle frame, or best by a splint taking its fixation point from the upper teeth. On the cheek and chin, pressure is applied with difficulty. In any case a dental appliance carrying an arm to press the mold on to the graft is indicated. Further, a splint fixing the mandible in the open bite position will inhibit most cheek movements, while the head itself may be secured by a jury mast. Another and effective method of graft fixation is illustrated in Figure 34, in which a large Wolfe graft was applied to the lower lip and chin, and pressed there by a mold of dental composition, which is itself fixed by cross sutures from areas beyond the margin of the graft. In Figure 34 little rolls of gauze were used to prevent cutting through of the retaining sutures.

Thiersch grafts. For burned faces the Thiersch graft finds its best use when applied to the eyelids by the author's epithelial outlay operation. This was described by him before the Ophthalmological So-

[1] To cut a forehead flap in rhinoplasty one-third larger than pattern is, in the author's opinion, entirely wrong. It should be cut to an exact pattern so that natural moderate tension occurs in its new position.

Fig. 34. Wolfe graft to chin, "stent" or dental mold composition pressing the graft on to its bed.

ciety of England in May, 1918.[1] Its principle depends on the method of skin grafting described by Esser as the epithelial inlay, which was designed for entropic conditions. The author modified it for ectropic conditions.

Technique for upper lid ectropion follows (Fig. 35): To deal with the deep scar tissue that usually exists between inner canthus region and nose, an extension of the skin graft is carried from either upper or lower lid operation. In other cases a separate graft at a later stage is placed over this area, and pressed into position by a crescentic shaped mold which is only partly buried.

The results of the outlay operation, both in appearance and function, are uniformly good in all cases of ectropion, except that class in which the musculature of the lids has been destroyed by fire. Improvement only is to be expected here. Disappointment also must be anticipated when a graft is applied to a bed, the tissues of which are still undergoing contractile fibrotic processes. The graft at first appears perfect and adequate, but as the underlying tissue contracts the graft shrinks with it. Such failure must not be attributed to the graft or to the method, but to the choice of operation time. In the interests of the patient's eyesight, such a too early operation may have to be undertaken, but an emergency covering to the lid is better found by using a forehead or cheek flap if available.

[1] Tr. Ophth. Soc. of England, 1918, May.

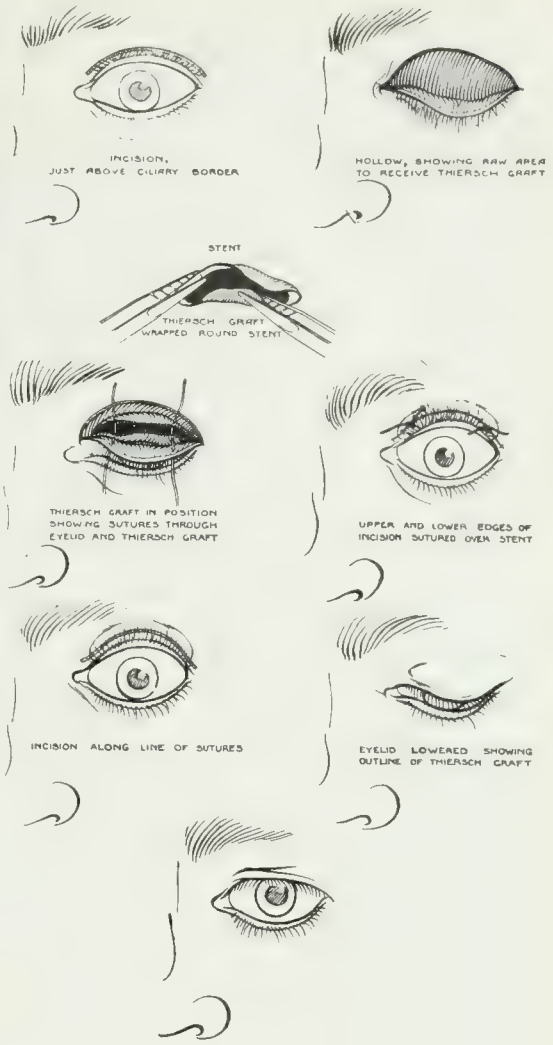

INCISION, JUST ABOVE CILIARY BORDER
HOLLOW, SHOWING RAW AREA TO RECEIVE THIERSCH GRAFT
STENT
THIERSCH GRAFT WRAPPED ROUND STENT
THIERSCH GRAFT IN POSITION SHOWING SUTURES THROUGH EYELID AND THIERSCH GRAFT
UPPER AND LOWER EDGES OF INCISION SUTURED OVER STENT
INCISION ALONG LINE OF SUTURES
EYELID LOWERED SHOWING OUTLINE OF THIERSCH GRAFT

Fig. 35. Diagram of the author's "epithelial outlay" operation. Modified from Esser. Drawn by S. Hornswick.

Other practical failures of this operation are due to failures of technique arising from non-observance of the following points: The graft should be well and evenly cut in one piece (thick grafts are not contra-indicated except that they are more difficult to handle); every part of the mold must be covered by the graft which should be gently stretched over it so that no wrinkles or excess skin remain. (Examples of the outlay operation are illustrated in Figure 36.)

Fig. 30. A typical case treated by the "epithelial outlay" operation. Cordite burn with very severe cicatricial ectropion.

After-treatment in the various methods described, differs with each method, as well as with each individual case. The Thiersch graft requires none until the removal of the mold, 7 to 10 days; Wolfe grafts have the pressure maintained for 3 to 5 days as a rule. After this the state of the transplant determines the treatment. Hot saline dressings promote circulation in the new graft, but cases also do well when no dressing is applied. Inflamed areas around stitches should be instantly dealt with, and collections of fluid expressed.

As early as the third day it is possible to label portions of the graft as definitely taken, while it may be as late as the tenth day before a definite circulatory life appears in other parts of it. In other parts again, the superficial epithelium alone desquamates, while complete failure can only be recorded when the graft comes away as a black layer in its entire thickness.

In regard to large flaps of doubtful vitality much of the above applies, but the most successful method of treating such a flap would appear to be by keeping it warm and moist, from the time of operation until the danger is past. Thus the circulation in the end vessels and spaces is aided so that stasis and thrombosis do not so readily occur.

In the efficient fixation of the graft, and in the artificial promotion of its circulatory activity by warmth, electricity, or chemical processes, lie the promise of progress in successful Wolfe grafting.

GUNSHOT FRACTURE OF THE FEMUR[1]

By SIR ANTHONY BOWLBY, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., London

GUNSHOT fracture of the femur occurs in about one and a half per cent of all wounded men. It is one of the most dangerous injuries of war, but it must be realized at once that the danger is proportionate to the extent and nature of the injury of the soft tissues even more than to the extent of the bone lesion Thus, it is well known that a spent bullet which glances off the femur and just breaks it may cause a minute entry and exit wound and a fracture which is much more like a simple fracture than a compound one. On the other hand, a large shell fragment may tear away the greater part of the hamstring muscles and the skin covering them, and may inflict so severe an injury that even if the femur is not fractured, the lesion of the soft parts alone may well prove fatal.

In the South African War of 1899 to 1902, it was the former class of fracture which predominated, for, not only were there very few high explosive shells used, but the rifle bullets were generally fired at a range of over 1000 yards and were of a shape which caused the minimum of injury to the soft tissues and the very smallest wounds of entrance and exit. It thus happened that the majority of cases did well, and that the experience of fracture of the femur in the South African War was of but little help in 1914, although it did demonstrate very clearly the value of the "Hodgen" splint, and its superiority to the time-honored "Long Liston."

In the recent war, fractures of the femur were generally inflicted either by wedge-like bullets fired at quite short range from machine guns, or else by fragments of high-explosive shells which were often very large, being parts of shells which themselves weighed from 60 to 200 pounds or more. Extensive tearing of the muscles was therefore the rule, and in many cases the patient had other wounds in addition. In the early days of the war, shrapnel shell was extensively used by the Germans, and it was much used by both the British and the French throughout the whole war. The lower velocity of its round bullets caused it to produce much less injury to bone and muscle, than the rifle bullet fired at short range or than the fragments of high-explosive shell.

Another very important factor to be considered in estimating the danger of fracture of the femur is the length of time that is often liable to elapse before the patient can be adequately treated. If in France a man were wounded in our own trenches or in billets there was very little delay, but, on the other hand, if he was wounded in an attack on the enemy's position it was often impossible to attempt to move him until nightfall, and he could not, of course, help himself to get to an aid post. The result was that before the patient could be treated he was often weakened by continued bleeding, by hunger and thirst, or by exposure to cold through lying out in mud and water, or through being soaked by heavy rain.

Conditions such as these will always cause a very high rate of mortality, whatever treatment is adopted.

TREATMENT

The treatment of these fractures falls naturally into two divisions: first, treatment at the front; second, treatment at the general hospitals.

TREATMENT AT THE FRONT

At the beginning of the war the splints supplied at the British front were very inefficient as well as very few, for the only splints available were long wooden splints of the Liston type, but both too thin and too narrow to be satisfactory. A rifle made a better splint. Within a few months I was able to obtain supplies of stouter splints made with a metal bracket 8 inches long so as to permit access to the wound, and these proved very serviceable and were employed for nearly a year and a half at the aid posts and field

[1] Presented before the Clinical Congress of American College of Surgeons, New York City, October 20, 1919.

ambulances. In 1915, Colonel Max Page devised a splint made of flexible metal and of the "Thomas" type, and by the end of the same year Sir Robert Jones's advocacy of the "Thomas knee splint" had resulted in its employment in many units. At about the same time, Sir Cuthbert Wallace, in conjunction with Colonels Richards and Frankau, perfected the now well-known "stretcher-suspension-bar" which enabled the patient to be carried on a stretcher with the lower extremity suspended. The use of the Thomas splint was soon adopted throughout the entire front and was demonstrated by the consulting surgeons in every field ambulance in the British Army. The application of what came to be called the "Thomas outfit" (i.e., Thomas knee splint and suspension bar) was also taught to all the field ambulance orderlies and regimental stretcher bearers, and it was further ordered that when a man with a fractured femur was found on the battle field the splint was always to be applied before the trousers were cut open or the wound dressed, and that the boot should also be left on the foot. The object in view was to immobilize the fracture before the limb was much handled, and also to apply the splint with as little loss of time as possible. A back-splint or a kettle-holder splint was often applied in addition.

When the use of the "Thomas outfit" became general the transport of the patient to the casualty clearing station was very greatly simplified, for, as soon as the limb was fixed in extension and slung, pain was either altogether prevented or reduced to a minimum, bleeding was soon checked and the steadying of the fragments effectually prevented further injury to the soft tissues and the spread of sepsis. The consequence was that patients arrived in infinitely better condition than previously, and shock was no longer so serious. The value of this early splinting of fractures was unexpectedly demonstrated when in May, 1918, several French Divisions came to the Kemmel area. Their journey had been hurried, and efficient splints had not been provided, so that when fighting began many patients arrived in British casualty clearing stations with fractures unsplinted. The condition of these men was an object lesson to those who had not been at the front in the earlier days of the war, for evidence of shock and loss of blood predominated in them, while the cases arriving at the same casualty clearing station from the British field ambulances were in good condition. The necessary splints were at once provided.

The method I have sketched of applying first-aid treatment to cases of fractured femur was not materially altered in the British Army during the last two and a half years of the war. It is, of course, very probable that further improvements will be developed, but it appeared to us when hostilities came to an end that for the time being we had found a very efficient method of treating these fractures on the battle field.

We found that the best means of applying traction on the field was by steel calipers fixed to the sole of the boot below the instep. In the absence of these a steel skewer may be passed through the boot leather, but has the disadvantage of spoiling the boot. Either a clove-hitch bandage or a so-called "surgical spat" was liable to cause too much pressure on the thin skin of the dorsum of the foot and consequent sloughing if left on for long.

On arrival at the casualty clearing station the routine treatment was to anæsthetize the patient, then take off the splint and dressings, and thoroughly remove with knife and forceps all damaged tissues and foreign bodies. Before this could be done it was often necessary to employ measures to combat shock or loss of blood, and in most cases gas and oxygen were the anæsthetics for choice.

After the operation was completed the Thomas splint was again applied, but this time the extension was fixed to the skin by strapping or glue. Then, as soon as the patient's condition permitted, he was removed to the ambulance train, en route for the general hospital area

Primary amputation. In a large number of cases of fracture of the femur, primary amputation is absolutely necessary and should be performed as soon as the state of the patient permits. In the latter half of the war, the employment of improved methods of transport and of resuscitation enabled amputation

to be performed on many more patients than in 1914 and 1915.

The conditions which commonly necessitate early amputation may be briefly summed up as follows:

1. Complete smashing of large area of bone.
2. Extensive comminution of the lower articular end of the femur.
3. Laceration of the femoral vessels.
4. Extensive destruction of muscles or skin.
5. Gas gangrene.

It must be recognized that primary amputation for fracture of the femur is attended with a very much higher death rate than is amputation in the thigh for injuries of the leg, and also that the higher up the limb is removed the greater is the mortality. Primary amputation at the hip-joint is so uniformly fatal that it had better not be performed at all.

TREATMENT AT THE GENERAL HOSPITALS

The first duty of the general hospital surgeons was to operate on those cases which had not been operated upon at the front, and at the end of March, 1918, when all the casualty clearing stations of the Third and Fifth Armies had been forced to retire, the bulk of the operating work fell to the lot of the general hospitals. If, however, thorough excision had been satisfactorily performed at the front in good time, as was usually the case, then the patient on arrival was put to bed and allowed to remain undisturbed for a day or two, to recover from all he had gone through. During this period many patients improved very rapidly in every way.

In many cases, after this period of rest, another apparatus was substituted for the Thomas splint, and in the putting up of these fractures an immense amount of ingenuity and skill was developed throughout the whole of the bases in France. The names of Major Sinclair and Major Pearson must be given a special place in this relation because they were the earliest and most ingenious of the pioneers, but many other surgeons became equally deserving of distinction subsequently.

The details of the methods employed have been so well described and illustrated by various surgeons, in the *Journal of the Royal Army Medical Corps*, in the *British Journal of Surgery*, and elsewhere, that it would serve no good purpose if I were to follow in their footsteps. I will, therefore, only attempt to indicate the general principles which were common to most centers, merely premising that the greatest benefit and progress resulted when, at the end of 1917, certain hospitals in every area were specially selected and equipped for the treatment of fractures of the femur, and when the surgeons of these hospitals had acquired experience in the work.

PRINCIPLES OF TREATMENT

First. The first general principle which was universally adopted was that the apparatus employed should be a skeleton metal splint, and that this should be used so as to enable traction to be applied either directly downward or else in various degrees of abduction or flexion. This was the essential foundation upon which all else was based.

Second. The direction of the traction and the amount of flexion or abduction required were guided throughout by frequent roentgenograms. These were always taken by a movable X-ray apparatus brought to the side of the bed, and by the aid of these the position of the fragments was altered, so as to obtain accurate apposition. Without the frequent use of X-rays at the bedside it is not possible to obtain uniformly good results.

Third. The length of the limb was at first measured daily and afterward less frequently, and it was found most useful to keep a "chart of shortening" (or lengthening) over the patient's bed. It became the custom to apply extension until the injured limb was definitely longer than its fellow, as it was found that this gave the best end-results. It is most important to bear in mind that even when the main fragments of bone are separated by an interval of one or two inches, *the gap can be completely filled by new bone.*

Fourth. "Fixed" extension proved to be not so good as "continuous" extension. The traction can be employed either by fixing the foot and then lifting the end of the bed and letting the weight of the patient act as the extending agent, or else by applying weight traction. On the whole, the use of

the patient's own body weight was the method most in favor.

Fifth. Movements of the knee-joint were begun early, and slight flexion of the knee was always preferred to traction on the fully extended limb.

The early experience of the war had shown us that unless special precautions were taken, a permanently partially stiff knee-joint was extremely common. This might be due to (a) mild sepsis, (b) fracture near the articulation, (c) loss of elasticity and scarring, and adhesion of muscles, tendons, and skin. Captain Watkin Williams devised a very simple metal apparatus which was attached to the main splint and enabled the knee to be freely moved or fixed at any angle of flexion. Colonel Besley, of the Chicago unit, gave great help by the calipers which he devised. These were fixed above the condyles of the femur and were especially valuable for cases of fracture of the lower third of the femur, for their use completely overcame the flexion so common in these cases, and they also enabled the knee-joint to be freely moved without disturbing the traction on the femur. Many surgeons employed "caliper extension" for all their cases. It should be noted that if calipers are employed the following precautions are necessary: (a) rigorous asepsis, (b) avoidance of the synovial membrane, (c) avoidance of the thin articular bone of the condyles by fixing the calipers on the denser bone at the level of the adductor tubercle, (d) the use of any simple method for preventing the too deep penetration of the bone by the points of the calipers.

Sixth. For fractures about the upper third and the neck, the patient was placed either upon the hammock-like swing cradles invented and described by Major Sinclair, or else upon the special segmented mattress designed by Major Pearson. This latter was adopted late in 1918 by the Army Medical Department for the treatment of all cases of fixture of the femur under treatment in England, and has been fully figured and described by Major Pearson in his book.[1]

Seventh. When union was sufficiently advanced it was the custom to get patients out of bed while maintaining the length of the limb by the application of "walking caliper splints" fixed to the heel of the boot. If these were employed, the use of the limb accelerated the formation of callus, but if they were not provided, many limbs yielded and became bowed in attempts to walk.

Eighth. The treatment of the wounds was on general principles, but in the year 1918 very great benefit resulted from early "delayed primary suture" or from "secondary suture." Cases so treated showed a more rapid union of the fracture and a great shortening of the period of pyrexia. They also were much less liable to late necrosis of fragments and to secondary abscess. The natural result was a decreased mortality in sutured cases as compared to those unsutured, and a great diminution in the amputation rate. In cases which could not be sutured, the period of suppuration was often shortened by the employment of Carrel's methods.

Ninth. The question of the removal of bone was not entirely settled when the war ended. There was no doubt of the advisability of removing badly smashed fragments which had been completely separated. But, while most surgeons did not advocate the removal of more than this some operators followed the advice of Leriche and practiced "subperiosteal removal" of many of the partially detached fragments also. There seems no doubt that, on the one hand, the removal of all fragments which might necrose hastens the healing of the wound, while, on the other hand, this removal delays the union of the fracture, and in the opinion of some very competent observers has been responsible for permanent non-union in not a few instances.

THE MORTALITY AND THE RESULTS OF FRACTURE OF THE FEMUR CAUSED BY GUNSHOT WOUNDS

In the year 1917 a *rapport* by Lieutenant Colonel Max Page was read at a meeting of the Inter-Allied Conference in Paris. This *rapport* was the sequel to an enquiry in England as to the results of fracture of the femur in 1914, 1915, and 1916, and it was evident that many of these were very unsatisfactory. A large percentage of the patients

[1] Fractured Femurs. Pearson and Drummond, 1917.

was suffering from one or more of the following conditions:

1. Shortening of the limb of more than 1 inch, and sometimes of 2 or 3 inches.
2. Union of the fragments in bad position.
3. Stiffness of the knee-joint.
4. Sinuses.

In a smaller number of cases there was stiffness of the hip-joint, necrosis of large fragments, or imperfect union. A large proportion of the patients walked very badly.

These results made it evident that the methods of surgical treatment and the conditions for the hospitalization of patients in 1914, 1915, and 1916 were not satisfactory, although before the enquiry by Lieutenant Colonel Page early in 1917, many improvements in splints had already been adopted in France.

The previous conditions and methods of treatment may be very briefly described.

In the year 1914–1915 it had been necessary to send all patients to England as early as possible. This was due to the fact that there was not, at the time, sufficient accommodation in France for the large numbers of the wounded, but there is no doubt that the journey was bad for the patients.

During the same period the splints most commonly employed, both in France and England, were long wooden splints of the type known in England as "Liston's." Towards the end of 1915 skeleton metal splints began to be used in France, and during the year 1916 the "Thomas" splint came into universal use at the casualty clearing stations. During this year also the "stretcher suspension bar," for use with the Thomas splint (so long as the patient remained on his stretcher), became a part of the regular equipment.

It was during the Battle of the Somme in 1916 that for the first time during heavy fighting, both the Thomas splint and the "stretcher suspension bar" were supplied to the field ambulances of the Fourth and Fifth Armies, and, at the end of that year and in the beginning of 1917, both these appliances were sent up to the regimental aid posts of all armies and were commonly applied as soon as the stretcher-bearers found the wounded men.

During the year 1917 the patients *at the bases* in France were generally treated by skeleton metal splints and extension, by the methods demonstrated to the Inter-Allied Conference by Major Sinclair, but it became evident that yet better results could be obtained, and this object was achieved in 1918 by -

1. Retaining patients in France as long as possible before the journey to England.
2. The creation of special hospitals with specially trained staffs of surgeons and nurses.

The bombing of the hospital bases in France in June, 1918, resulted further in the creation of special hospitals for fractured femurs in England also, under the guidance of Sir Robert Jones.

The effect of these various measures was that many lives and limbs were saved, and that the limbs saved have shown very much less permanent disability than formerly

The *mortality at the front* in the early days of the War cannot be directly compared with the mortality at the front in the year 1918, because the conditions were totally different. In 1914–1915, whenever there was heavy fighting, practically all patients, however bad their condition, were at once sent to the base hospitals by ambulance trains, because the casualty clearing stations were far too few and too small to accommodate them; and very large numbers of patients merely passed through these units on their way to the train. Yet, even then, it was found that not less than 16 per cent of one thousand consecutive cases died at the front, and it was estimated that the total mortality in France was at least 40 per cent, exclusive of those who subsequently died in England, so that the death rate was altogether not less than 40 to 50 per cent.

These figures are, however, rather misleading, for all cases of fractured femur are included in them, and among these not less than 20 or 30 per cent had either such serious local complications as injury to the main vessels, extensive comminution into a joint, or widespread laceration and destruction of large masses of muscle, while many other patients had multiple wounds involving other limbs or the viscera of the thorax or abdomen. It is not always possible to differentiate

between all these conditions, and it must be understood that the figures used in this communication include all patients in whom the femur was fractured, whatever complications there might have been.

The total mortality in the year 1918 may be estimated from the following figures. It has been found impossible to ascertain accurately the exact number of all cases and the results in all casualty clearing stations, because of the difficulties encountered in the retreat of March and April, but sufficient records have been obtained to enable satisfactory conclusions to be drawn.

AT THE FRONT

Of 3,141 cases admitted into various clearing stations, 550 died; i.e., 17.5 per cent. Of these cases approximately 21 per cent were treated by amputation. The mortality of the amputated cases was about 33 per cent. These are included in the total 550 deaths recorded above.

It was estimated that in between 20 and 30 per cent of the total number of 3,141, there were multiple wounds or such other serious complications as have been alluded to above. The mortality was very much higher in this class than in the remaining 70 per cent.

AT THE BASE HOSPITALS

During the year 1918, there were treated in the General Hospitals at the bases in France, 5,025 patients. Of these 547, or 10.8 per cent, died. Of these 5,025 cases, 513 were treated by amputation, or 10.2 per cent. The mortality of the amputated cases was about 33 per cent. All these are included in the figure of 547 given above

Enquiry in England shows that the mortality in the special hospitals more recently created has been very low and has generally been about 1 or 2 per cent. This is due to the fact that, first, the majority of all the cases were kept in France in 1918 until union had occurred and the wounds had healed; second, even in times of stress the worst cases were always retained in the special hospitals in France.

Amputations in England have, for the same reasons, been few.

From a consideration of the above figures it may be concluded that during the year 1918 the *total mortality* of all cases of fracture of the femur at the front, at base hospitals in France, and in England, amounted to, approximately, 30 per cent.

It must, however, be again pointed out that a very large proportion of the deaths occurred in men who had other serious injuries, and there is no doubt that in not a few of these, death was not due to the fracture of the femur, but to wounds of the viscera or to the shock caused by multiple injuries. My own impression is that the mortality of uncomplicated fractures of the femur due to "gunshot" wounds, and treated throughout by the most modern methods is not more than 20 per cent, and this conclusion has been arrived at after a long experience of these cases both at the front and in the base hospitals, and after an examination of many statistics.

AMPUTATIONS

A very large number of the deaths followed amputation, and about 27 per cent of all the patients with fracture of the femur lost the limb either by primary or secondary amputation. It will also be noted that in one-third of all the amputations, the operation failed to save life.

At the front the most common cause for amputation was that the extent and severity of the injury rendered it impossible to save the limb. In other cases laceration of the main vessels was the cause. In many cases the operation was performed for gas gangrene.

Many lives were saved by the employment of blood transfusion and by the use of gas and oxygen as an anæsthetic.

At the base hospitals the presence of gas gangrene was almost as often the cause of amputation as at the front, but in a good many cases the development at a later stage of intractable sepsis called for the removal of the limb. It must, however, be remembered that in March and April, 1918, several hundred cases had to be sent to the base for operations which would ordinarily have been performed in the casualty clearing stations.

The following figures of one general hospital may be taken as examples. Out of 71 amputations, gas gangrene caused 24; acute sepsis,

29; dry gangrene, 3; secondary hæmorrhage, 9; osteomyelitis, etc., 6.

FINAL RESULTS

The final results obtained in the limbs that were saved show a very great improvement on those of the early part of the War. They may be briefly summarized as follows:

1. *Shortening.* The methods of treatment of 1918 guarantee that unless there has been very extensive loss of bone no shortening need occur. It has been shown that even when 1 or 2 inches of the femur have been destroyed, the gap can be filled by new bone, and that, consequently, there is no objection to maintaining the fractured ends in full extension.

It had formerly been the practice of some surgeons to allow the separated fragments to come together so as to promote union, but it is certain that this should not, in the future, be a regular practice.

Practical experience has also shown that it is more difficult to obtain a full-length limb in cases of simple fracture, such as occur commonly in civil practice, for the uninjured muscles offer far greater resistance than those in a limb wounded by shell or bullets, and more extension is, consequently, required. The amount of shortening following gunshot fractures is shown, by the following figures, to have steadily decreased in each year of the War.

For these we are indebted to Major Stout, N. Z. M. C., and they include every case of fractured femur in the New Zealand Corps.

NEW ZEALAND FIGURES

Year	Cases	Average Shortening in Inches
1916	54	1.345
1917	116	.957
1918	90	.25

TWO SPECIAL BRITISH GENERAL HOSPITALS IN FRANCE, 1918

Cases	Average Shortening in Inches
343	0.2
60	0.2

Of these 60, 36 had no shortening.

Major Pearson, S. A. M. C., has supplied the following figures:

A SPECIAL HOSPITAL IN ENGLAND, 1918

Cases	No Shortening	Average Shortening of the Remaining 29 Cases
68	39	0.5 inch

Other hospitals show similar results, and it will be seen that the majority of the patients recovered without any shortening and that in only about 5 per cent of all cases was there more than 1 inch of shortening. Thus, of the 90 New Zealand cases in 1918, only two had more than an inch of shortening, and both of these patients had lost a good deal of bone.

The records of the various special hospitals necessarily vary somewhat, but the figures quoted are sufficient to prove that the previous difficulties in obtaining limbs of good length after gunshot fractures of the femur have been completely overcome, and that equally good results should be generally obtained in civilian practice as well as in war.

2. *Malposition.* The commonest displacement is a falling back of the lower fragment. The difficulties of correcting malposition almost disappeared in France as soon as a full length limb could be secured. A small percentage of the fractures near the knee and the hip recovered with some displacement remaining, but at least 80 per cent of the whole of the cases recovered with good position.

In fractures of the shaft, good position can practically always be secured, but it is most important thoroughly to support the bone at the site of fracture so that the natural anterior curve of the femur is either very fully maintained or even slightly exaggerated.

3. *Stiffness of knee-joint.* Major Pearson reports that of 68 cases, the number with a range of knee flexion over 90° was 55; the number with a range of knee flexion 60° to 90°, was 10; and the number with a range of knee flexion 30° to 60°, was 3. None had less than 30° of movement at the knee.

Of the New Zealand 264 cases, Major Stout reports the average range of flexion of the knee over the whole series was 43°.

Many other hospitals show similar results, and it is evident that there has been a great diminution of those cases in which the knee is left permanently stiff. There is no doubt that if suitable precautions are taken during treatment stiff knees in cases of fracture in the shaft of the femur should be very few.

4. *Stiffness of hip-joint.* This has not been a frequent complication, and it should never occur except in cases where the fracture

involves either the neck of the bone or the trochanters.

5. *Stiffness of ankle-joint.* This can always be avoided if care is taken not to keep the foot cramped by bandages, and to allow and encourage daily movement at the joint.

6. *Sinuses and necrosis.* Sinuses are seldom met with in the absence of necrosis, and as it has been the custom recently to remove sequestra earlier than in former years, the total number of patients with sinuses has greatly diminished.

7. *Non-union.* This is decidedly rare, and did not occur in more than about 1 per cent of the cases retained in France.

8. *Nerve injuries.* These are much more common than was generally appreciated. Out of a total of 297 cases of fractured femurs observed by Major Stout, important nerve injuries were found in 12 per cent, i. e., in 36 patients. The injured nerves were: the sciatic in 13 cases; the internal popliteal in 3 cases; and the external popliteal in 20 cases.

POSTOPERATIVE TETANUS

By R. R. HUGGINS, M.D., F.A.C.S., Pittsburgh

IT is difficult to conceive a more horrible ending to what would seem a normal convalescence, than death from tetanus. Reports in literature of postoperative tetanus are few and the various theories advanced show that there is much doubt as to why this unusual complication should follow in the wake of what has been considered clean operative technique. That a considerable proportion of the cases reported have occurred after abdominal operations makes this subject worthy of some attention on the part of the gynecologist. The limited number of such cases also suggests the necessity for careful study and the report in detail when it occurs. The wide distribution of the tetanus bacillus and its frequent occurrence in contaminated wounds under certain circumstances lead to the conclusion that we have been fortunate in having so few cases in our surgical work. That it should occur so much more frequently in intra-abdominal and pelvic work than in surgical procedures elsewhere commands attention. Many theories have been advanced concerning the predisposing causes of postoperative tetanus.

Pizzini has made the statement that 5 per cent of all normal men carry tetanus bacilli or the spores in an active state in the intestinal canal. This percentage is increased in all individuals working as drivers, hostlers, dairymen, etc. He suggests and urges preventive measures in cases to be operated upon which consist in depriving the patient of all raw vegetables, fruit, etc., for several days before operation.

Rudolph Matas states that in 2 cases the patients ate uncooked vegetables freely 24 and 36 hours previous to operation. He further notes the danger of tetanus in operations around the rectum, genital and lower pelvic regions.

Insen reports a case operated upon for tubercular peritonitis. The symptoms of tetanus began on the sixth day, death following in 34 hours. Cultures from the wound were negative. He agrees with Matas that the origin is in the intestinal canal, and organisms gain entrance with uncooked vegetables. He agrees with Matas in the necessity for prophylaxis by free purgation 4 or 5 days previous to operation and withholding all uncooked vegetables and fruit for that length of time. He is of the opinion that the normal defenses in healthy individuals protect them even though the tetanus bacilli may be present in the intestinal tract in large numbers. This is perhaps the only way to account for the great number of patients, who survive operations performed in fæcal contaminated areas.

Gum reports 4 cases, one of which was doubtful. After careful examination and cultures from air, ligatures, dressings, and everything associated, he came to the conclusion that the infection was carried by water. Examination of the water was negative but the soil which the water received as drainage was positive for tetanus bacilli. Other hospitals with the same water supply, however, had no tetanus. Examination of the cistern of the hospital revealed fungoid bodies but it was negative for tetanus bacilli. After removal of the cistern no more cases developed.

Hirst reports a few cases postpartum in which infection seemed to follow douching, the water evidently being contaminated. Catgut has been looked upon with a great deal of suspicion, but there are few cases in fact where it has been definitely traced to catgut. In many of the cases reported all cultures from the wound, fluids and catgut were negative.

Murphy reports a case which occurred in a milkmaid and at first she was thought to be a carrier. Later it was discovered that a surgeon in Calcutta had 3 cases and that he had used the same brand of catgut and that it had been shipped the same day. Other surgeons used gut made at the same time without any untoward results.

C. Nicholle reports a case that occurred in a hospital in Tunis where inoculations of animals made from the catgut showed positive results, the animals dying of tetanus. He states that the catgut was sterilized by chemical means. This is perhaps the only case where the responsibility was definitely fixed on catgut.

Richardson reported 2 cases and collected 21 from the literature. In 14, bacteriological study was made and a bacillus resembling tetanus was cultivated from the catgut in 4, but no animal died of tetanus after inoculation of the cultures. He refers to a paper by D. J. Hamilton on looping ill or sickness which occurs among sheep in certain parts of England. This bacillus resembles tetanus but its inoculation in animals will not produce tetanus. He suggests that the disease we call tetanus is one of the sheep diseases.

As German catgut was used in all of the 21 cases reported except one, there can be little likelihood of this form of infection being present in any of this series.

Wickersham has pointed out that the packing house receives practically nothing but range sheep in America, and that tetanus is not only rare among sheep but is almost unknown in range sheep. It would seem that the methods employed at present by all reliable manufacturers should kill the tetanus bacillus beyond any doubt.

Behrend collected 24 cases, only 3 recovered. He concludes that catgut is probably excluded as a causative factor. The absence of any definite knowledge as to how this infection gains its entrance, the high mortality and the tragic death when it occurs, all suggest more careful study of this dangerous complication. That it occurs so seldom does not permit indifference as it may happen at the most unexpected time. The experience of the writer would lead to the conclusion that some individuals possess a certain predisposition to tetanus. That such a thing as an inherent tendency exists and increases the susceptibility to certain forms of infection is probably true.

The following case is presented as one of tetanus, although the clinical diagnosis which was made from typical symptoms was not proven bacteriologically:

Mrs. A. B., age 48, Hosp. No. 89,147. This patient was admitted to St. Francis Hospital for operation January 6, 1919. She gave the history of an atypical menstrual flow and a period of bleeding some months previous to admission. The body of the uterus contained a small fibroid. The cervix was extensively diseased as a result of laceration and infection with chronic inflammatory change. The patient was extremely nervous and apprehensive. She had been advised to have an operation several months before she finally consented. During all this time she worried and could not persuade herself that she could undergo the ordeal safely and seemed constantly on the alert and filled with the idea that something would surely happen. This continued even after the operation was over. On the seventh day she insisted that something would turn up, although at that time she was in the best of condition. After admission she was kept in bed for several days and every care given to a study of her general condition with the view of not operating if any contra-indication was found. At the end of that

time the patient was much more composed and more optimistic. No reason could be found why there was any unusual risk and the operation was done.

Operation, January 11, 1919. Ether anæsthesia. After amputating the cervix with cautery, a piece of iodoform gauze was placed in the vagina. *Laparotomy.* The abdomen was opened in the midline. The uterus was found as above described, freely movable with no pathological change in the adnexa. The tubes and ovaries together with the uterus were removed in the usual manner; the raw surfaces being covered over with a flap of the peritoneum. A single cigarette drain was placed in the cul-de-sac. The peritoneum was closed with catgut, the fascia with interrupted sutures of catgut, fascia and skin with interrupted sutures of figure-of-eight silkworm-gut. The patient did not take her anæsthetic very well and the abdominal muscles were quite rigid throughout the operation. She left the table in good condition.

On section of the uterus, a small fibroid about the size of an almond, composed principally of connective tissue, was found located in the right side of the uterus between the layers of the broad ligaments; a number of small fibroids about the size of peas were scattered throughout the uterus. The entire musculature of the uterus was thickened and in certain places cut like scar tissue. There were several small areas just beneath the mucous membrane which were extremely hard.

Examination of the gall bladder revealed the presence of two gall stones which were not removed. The appendix was normal and was not removed.

Postoperative notes. January 22, 1919. Aside from some vomiting and considerable distention for the first 18 hours, the patient made an uneventful recovery. The patient's condition continued to be very good until January 10, 1010. During the day, she had some little stiffness of the masseter muscles but did not mention it to anyone; that night the stiffness became pronounced and the patient was unable to open her mouth, although the condition was not alarming. She said it was not at all strange to her as she had had this same condition twice before when she was extremely nervous and exhausted from overwork; in her opinion it seemed to be due to a disturbed state of her nervous system. She was seen by the writer the following morning. At that time there were no other symptoms present but the stiffness of the muscles of the jaw and inability to open the mouth, although she was able to take liquids without any particular discomfort. There was no rigidity of the muscles about the base of the skull or neck nor was rigidity present in any other part of the body. On account of the history given by the patient, we were somewhat puzzled at this time and unable to come to a definite conclusion as to the presence of a true tetanus. With the patient insisting that it was the same as had occurred before, we tried to hope that her observations were correct. Her condition remained the same until the following day when more definite symptoms seemed to occur. There was greater inconvenience in attempts to swallow, and the muscles of the abdomen seemed to be more rigid; the muscles of the jaw were more fixed and swallowing became difficult. She was given 5,000 units of antitetanic serum that evening. During the night she had two convulsions which lasted about 15 minutes. The following morning she received 20,000 units in the spinal canal, 5,000 units into the blood stream, and 5,000 units subcutaneously. Her temperature, up until this time, rose gradually until it reached 101°F. After the administration of the serum it rapidly rose to 105.5°F. per rectum. The pulse which had been fairly good increased in rapidity. There was no improvement in the symptoms during the day, and while she was able to open her mouth fairly well and there was also considerable relaxation of the muscles in general she lapsed into a state of unconsciousness and died at 7:15 p. m.

The interesting points in the discussion of this case were: First, the extreme nervousness of the patient. She was very apprehensive about the outlook and had postponed the operation for many months on this account, and from day to day even while she was making a perfectly normal convalescence, she seemed frightened and worried for fear something might turn up. Second, there was no apparent evidence of any local infection; the wound healed *per primam.* Her general condition and temperature suggested a normal convalescence to the time of the development of the above symptoms.

Smears and cultures were made from the abdominal wound which had healed without any evidence of infection. Cultures were also made from the vagina. No growth could be obtained which in any way resembled the tetanus bacillus. This was true also of the catgut used at operation. This is the first case of the kind in the history of the hospital and the absence of positive cultures from any part of the operative field leads to some confusion. A study of the spinal fluid was also negative.

A case such as described suggests the possibility of false tetanus under certain circumstances. The history given of two previous mild attacks lasting for several hours suggests the idea that the symptoms were due either to nervousness or that the woman had been a tetanus carrier and that the previous attacks had been a mild form of tetanus.

CONCLUSIONS

The study of the histories and comments on the various etiological factors as advanced by the men who have written on this subject suggests the following conclusions:

1. That tetanus is a complication which may follow any operative procedure but is more likely to follow abdominal or rectal operations.

2. More thought should be given to the possibility of its occurrence and, with this in mind, all green vegetables should be withheld for several days before operation.

3. There is danger in all operations around the rectum, genital, and lower pelvic regions.

4. It is significant that the Surgeon General of the U. S. A. ordered a prophylactic dose of tetanic serum given before all rectal operations during the late war. It is probable that this may become routine under certain circumstances.

UNUNITED FRACTURES OF THE HIP[1]

By M. S. HENDERSON, M.D., F.A.C.S., Rochester, Minnesota
Chief of Section on Orthopedic Surgery, Mayo Clinic

FRACTURES of the neck of the femur, commonly called fractures of the hip, occurring as they often do in the elderly person, present surgical conditions demanding the greatest care both in diagnosis and treatment. While this is true of all recent fractures of the hip, it is doubly true with regard to the treatment in the unfortunate group of cases in which bony union has failed. It is to the patients in this latter group that our attention is directed in this paper. A review was made of 120 cases of fractures of the surgical neck of the femur in which bony union had failed. While in a few instances fibrous union had become sufficiently firm so that restricted activity was possible without the aid of crutch or cane, in not a single instance, to our knowledge, except following operation, had bony union occurred.

It was our endeavor to determine if possible the reason for the non-union, whether operative procedures were justifiable, and, if so, what type of case was the most suitable for surgery. Ordinary manipulative procedures, such as Whitman's abduction method or Cotton's impaction method as applied to recent fractures, were not considered. By the term surgical procedure is meant the opening of the joint and the exposure of fragments, with such measures as seem best to promote union. It has been suggested by Brackett to place the tip of the trochanter, denuded, against the denuded head and thus attain bony union, but with this I have had no experience.

There were 68 males and 52 females in the series. Twenty-six were operated upon, and 94 were dismissed, nothing having been attempted to relieve the condition. Five patients were between 20 and 30 years; 20 were between 30 and 40; 20 were between 40 and 50; 46 were between 50 and 60; 24 between 60 and 70; 4 between 70 and 80; and one between 80 and 90.

After carefully reviewing the case records of these patients, the outstanding points established were that the non-union in the majority resulted from an incorrect diagnosis at the time of the accident, and that in the minority, even when the proper diagnosis had been made, no treatment had been carried out, often, it is true, for some justifiable reason. In a certain few the measures used had been rather in the form of a surgical ritual and were not in any sense of the word adequate. It was astonishing to ascertain how often elderly persons, who after a severe fall were disabled on account of intense pain in the hip, were told without being carefully examined that they were suffering from a sprain, the fracture not being diagnosed until months

[1] Presented before the Section on Orthopedic Surgery at the Seventieth Annual Session of the American Medical Association, Atlantic City, June 13, 1919.

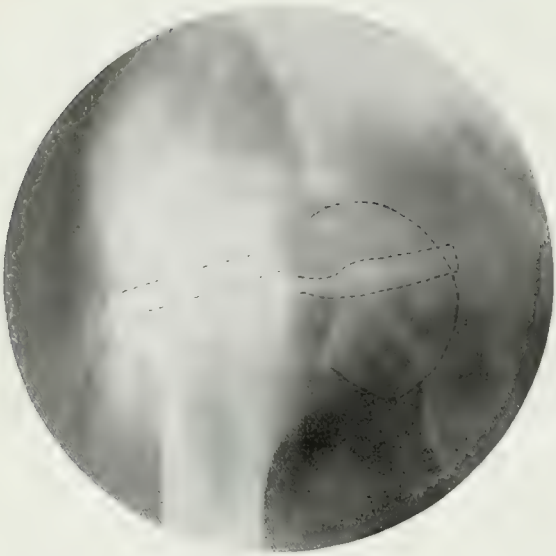


Fig. 1. Fracture of bone peg (tibia) probably due to fact that the bone peg was driven in so far that it engaged the acetalulum.

later, usually by another consultant. Another somewhat common story was that the physician who was called in, carefully measured the legs and finding no shortening or eliciting no crepitus, diagnosed a sprain without resorting to radiography. Weeks or months later, a consultation necessitated by continued disability revealed shortening of the affected leg, crepitus on manipulation, and a roentgengraph established the diagnosis of fracture. The probable explanation of this is that what was originally a more or less weakly impacted fracture, broke down through inadequate fixation of the limb. In none of the cases in this series was there a history of really proper treatment for the fracture. Good treatment had been instituted in a few instances but for some reason it was not prolonged enough. The patient may have been unruly, the supervision too weak, or complications, such as impending pneumonia, may have necessitated a discontinuance of treatment.

The fact that of the entire series of 120 patients, 94 were, for various reasons, denied the benefits of surgery, clearly shows that ununited fractures of the hip are not popular surgical risks. The mortality rate in the group of 26 patients was nil and in none of the cases did symptoms that were regarded as serious develop after operation. It is very evident that we must look farther to explain the low operative percentage. From a technical point of view, the operation is formidable. The incision must be large enough to permit of as free an approach to the hip-joint as possible, and care is required to prevent contamination during the manipulations necessary for exposure of the fragments. If an autogenous bone graft is to be used, the procedure is further complicated by a second wound and its care. Many of the patients are old, and have a low expectancy. The length of time necessary to complete the treatment and convalescence is comparatively great, and the general health in the elderly is often such that it does not seem justifiable to subject them to the risk of the operation and the confinement. The reparative properties of bone in persons of more than 45 or 50 years is not so great as in younger persons. The social status of the patients may be such that they cannot afford to pay even their living expenses while under care. Many patients present themselves years after the accident when the neck of the femur is completely absorbed. In cases otherwise suitable for operation, total absorption of the neck of the femur occurs, and it has been learned from this study that so far as any of the procedures herein considered are concerned, operation should not be done in this group. The fact that in our experience bony union is difficult to secure by any means at present known, considered with the aforesaid difficulties, is sufficient to make us very cautious with regard to prognosis. In some instances, all things considered, surgery is advisable, but, knowing that the results are uncertain, one does not feel justified in strongly urging the patient to submit to the operation.

It is unfair to take the percentage of cures that resulted in the 26 patients operated upon as a standard. Not a few of this group who we now know were not the best subjects for surgery were subjected to operation. Conclusions will, therefore, be drawn rather from the clinical experience gained than from any of the tabulated statistics. Twenty males

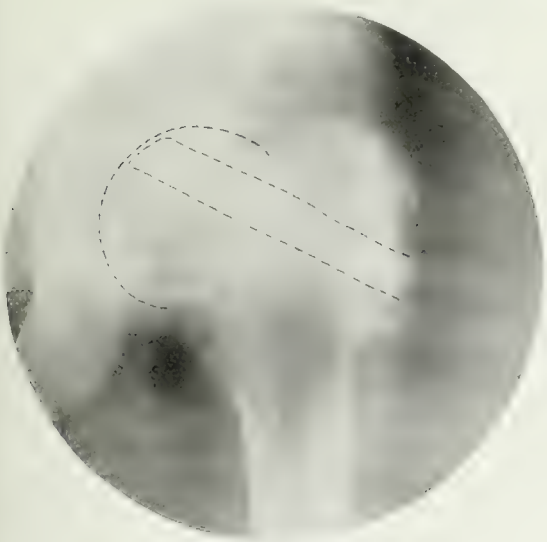


Fig. 2. Bone peg (fibula) properly placed.

Fig. 3. Total absorption of the neck of the fibula in a female aged 25, 6 months after accident.

and 6 females were operated upon. Two were between 20 and 30; 6 between 30 and 40; 7 between 40 and 50, and 11 between 50 and 60. The duration of the non-union varied from 3 months to 3 years, an average of 13 months. Nails or screws were used in 8 cases, and bone in 18. There were, as I have stated, no deaths, and infection, which fortunately was not serious, developed in but 2. The operative field is rather difficult to keep clean in these cases, but a fracture table, such as the Hawley table, makes the entire procedure easier. Plenty of assistance must be available, and the best of technique and care must be taken to provide proper postoperative fixation. It has been our experience that a plaster-of-Paris cast affords the best means of maintaining the proper position. There is some controversy whether the bone graft or metal pegs should be used. Both are foreign bodies but the bone graft is absorbed. Consecutive roentgenographs of given cases show that the bone graft is gradually absorbed and is replaced by bone normal to the neck of the femur. Some of our patients treated with metal nails and screws have them in place years later with no inconvenience. We have used nails and screws, autogenous bone grafts, and beef bone screws. The last named are not best suited for the type of case under discussion but are most convenient in operating upon recent fractures of the hip.

Eight patients were operated upon with metal as a fixative with only one known good result, 3 with beef bone screws, and 15 with autogenous bone grafts. Various methods were employed with the bone graft. First the peg obtained from the tibia was tried; later packing the space between the head and the neck with bone was tried by placing therein two or three short grafts. It was hoped thus to re-establish a portion of the neck, but both of these methods have been abandoned for the use of the fibula, as advised by Davison. The curved U-shaped incision is used. The tip of the trochanter is removed, the method popularized by Murphy, as this has been found to give the best approach to the joint, and at the same time to give opportunity for inspection. In placing the graft from the fibula, care must be taken that the tunnel through the trochanter and the hole in the head are made the proper size so that the fit is snug, but not too tight, and that the angle at which the graft is placed is at least the normal angle of the neck to the shaft of the femur. Fixation

in a plaster-of-Paris spica cast, extending from the foot to the chest with the hip held in abduction, is maintained for at least 3 months. A great deal of comfort will be afforded the patient if the cast is not extended up on the chest wall on the side of the affected limb; this is not necessary for fixation since the limb is already in abduction.

It is not so easy as might be supposed properly to place a bone peg in a fractured hip. Care must be taken that the channel for it in the trochanter is correct. The peg must be placed deeply enough in the head, which is often poorly nourished, to get a good hold, but not so deeply that it engages the acetabulum, for in such cases a fixed point is formed on the pelvis and any appreciable motion of the thigh will act as a fulcrum and throw so much strain on the graft that it will break (Fig. 1). If the peg is properly placed, the head travels quite easily with the graft which readily stands the strain until sufficient new bone has formed to make bony union complete (Fig. 2).

The end-results of the operation in 7 of the 26 patients are not known; 10 operations were successful; 8 are known to be failures, and 1 patient is still under observation, but the result promises to be good. Thus there are 38 per cent good results; namely, bony union and good function. Of the entire series of 120 patients coming for relief, only 10 (8.3 per cent) were improved.

CONCLUSIONS

1. The most common cause of non-union is that the fracture is not recognized at the time of the accident. The disastrous result, therefore, is the result of no treatment. In cases in which the diagnosis is correctly made the treatment is often faulty and weak. An impacted fracture must be kept impacted until united.

2. As a group taken at large, ununited fractures of the hip offer a comparatively small percentage suitable for surgery; 26 (21.6 per cent) of the 120 patients were operated upon. In 10 of the cases operated upon (38 per cent) the operations were successful, giving, however, for the entire group of 120 cases only 8.3 per cent successfully treated.

3. Advanced age, poor general health, etc., are contra-indications to operation, but the chief contra-indication is absorption of the femoral neck. A person of 25 years may, in 5 months after the accident, show so much absorption of the neck of the femur (Fig. 3) that none of the measures herein considered offer any hope.

4. Any means, in suitable cases, that will freshen the fractured surfaces and maintain them in apposition is sufficient, but autogenous bone pegs are the most ideal.

5. From our experience, the fibula seems to be the best piece of bone to be used; it is easily obtained, and is never missed by the patient if it is removed anywhere four inches above the external malleolus.

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OPERATION FOR ADVANCED CARCINOMA OF THE TONGUE OR FLOOR OF THE MOUTH

By VILRAY PAPIN BLAIR, A.M., M.D., F.A.C.S., St. Louis

CLINICAL observation has led me to believe that, in spite of their high mortality, the majority of carcinomata of the mucosa of the mouth and upper air passages are for some time after their appearance not very malignant, and the present high mortality rate is due chiefly to late or inefficient operation, or both. In spite of the reasonable hope that the time is not far distant when early recognition will render the simpler operations efficient for all but the more malignant growths, at present most of the cases that we are called to treat are so far advanced as to require the more radical operations and many are not properly operable by any of the classic procedures. It was the cases of cancer of the tongue and floor of the mouth coming under the latter classification that led to a plan of operation that in its thoroughness may be compared to the "radical" operation for cancer of the breast. Unlike the latter, I do not believe it to be recommended for all cases of cancer of the tongue. Butlin's (1) analysis of his own results would lead one to believe that, with subsequent operation on the lymphatics, the Whitehead operation is suitable for many if not most cases. On the other hand, Lenthal Cheatle (2) concluded from his histological studies that extensive involvement of the associated muscles was the rule in the cases he examined, and therefore that the intrinsic and geniohyoglossus muscles should be removed in all cases.

It is my present belief that the operation to be described is properly applicable to the more advanced cases especially those that also involve the jaw, the floor of the mouth or the base of the tongue, or those with palpable involvement of the submaxillary nodes, and to early cases where, after removal by a less radical procedure, examination reveals a high grade malignancy. I believe that it has a lower death rate than any of the operations that involve cutting through the jaw bone. It is easily and quickly done and gives speech results that compare favorably with partial removals, but, after total removal of the tongue, chewing is impossible and deglutition is very much impaired. It consists in the block removal of the tongue, the structures in the floor of the mouth, all muscles above the body of the hyoid bone and stylohyoid muscles, the submaxillary and submental lymph nodes and as much of the faucial pillars and pharynx as desired, together with thorough cauterization of the mandible wherever the ulcer approaches or involves it.

The operation is performed as follows: Forced fluids are given for twenty-four hours before operation, and a low *bloodless* tracheotomy is done, preferably under a local anæsthetic; if a general anæsthetic is given before the tracheal tube is inserted, septic material may be aspirated. I believe there are very certain advantages in having the

Fig. 1. Line of incisions from behind the angle of the jaw on one side to a corresponding point on the other crossing the mid line at the lower border of the body of the hyoid bone.

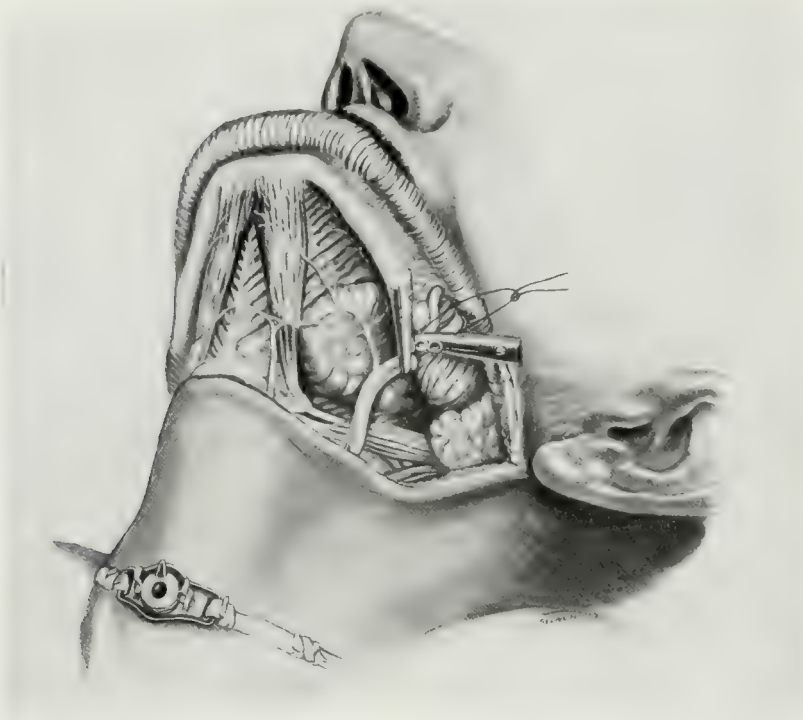

Fig. 2. Shows the skin platysma flap retracted upward and the facial artery and vein doubly caught and cut as they cross the lower jaw and ready to tie. In this figure and also in Figure 3, in order to identify them more easily, the muscles are shown stripped of their deep cervical fascia, but at operation they would be very much hidden by this fascia and usually by a deposit of fat.

tracheotomy precede the main operation by a day or more. The tracheal tube should be large—at least a No. 6, and long enough to reach well into the trachea; in a low tracheotomy the ordinary tube is not long enough except for very thin individuals. No attempt is made to clean up the inside of the mouth before operation; a person in ordinary health has some immunity to the organisms he habitually carries but trauma may destroy this immunity.

The incision shown in Figure 1 skirts the lower border of the hyoid bone and goes just through the platysma muscle. With two sharp, rake retractors, the skin and platysma above the incision are avulsed forcefully upward from the deep cervical fascia, cutting the more resistant strands of tissue and the blood vessels, until the lower border of the mandible and the facial vessels crossing it are well exposed. At the border of the jaw the facial artery and vein are caught with two forceps, cut, and tied above the normal site of the buccal node that lies on the vessels (Fig. 2). At the level of the skin incision the facial vein is divided between ligatures and after freeing the submaxillary salivary gland at its lower border it is drawn forcefully upward until the facial artery is well exposed emerging from beneath the upper border of the digastric muscle to enter the gland. As far as possible from its origin, an inch from the digastric if practicable, the artery is caught between two forceps, cut, and ligated. Then a search is made for any branches of the facial arising within one-half inch proximal to the ligature. There are usually two, a very small and a larger one, and these should be ligated. This assures a long clot in the cut stump of the facial artery. Just below the

Fig. 3. Shows the submaxillary gland of the left side drawn forcefully upward and the facial artery caught and ready to be cut and ligated as it enters the gland. The lingual artery is shown drawn out through a separation between the fibers of the hyoglossus muscle ready for ligation.

outer part of the digastric tendon, the fibers of the hyoglossus muscle are separated by thrusting in the points of dissecting scissors, and the lingual artery is grasped and ligated—Kocher's ligation — (Fig. 3).

The blood supply being now controlled, the excision is made with a cutting cautery starting at the symphysis and cutting through the digastrics, geniohyoids, geniohyoglossi and myohyoid muscles, stripping the periosteum and mucoperiosteum from the inner surface of the jaw. If the ulcer approaches the bone, prolonged cooking with a heavy cautery is done. The tongue is next drawn out through this opening which brings the pillars and the pharynx into plain view, the excision here being guided by the position and extent of the growth. Finally the base of the tongue is cut across right at the hyoid bone and I believe it is well also at this time to remove the lower part of each parotid gland on account of the closely associated lymph nodes.

The lower border of each digastric muscle is sutured to the anterior border of the sternomastoid with fine tannated gut, and the ligated facial artery stumps are left standing out free in the pharynx. This plan of treating the facial artery, in my opinion, is safer than burying it in tissue that may become septic. I have had several opportunities to observe the subsequent course which is, if the efferent branches have been ligated, that they become occluded by a clot and then shrink up and disappear. If subsequent bleeding should occur as it did in one of my cases, from an unligated efferent branch which tore loose in a coughing spell, the sutures can be removed and the bleeder is in plain sight. If moderately enlarged cervical nodes tend to protrude from between the sternomastoid and the digastric muscles, they are

Fig. 4. Shows the completed excision and the wound ready to close. Note that in this case the posterior pillars of the pharynx are left intact while the anterior pillars and the tonsils have been removed leaving the lower part of the internal pterygoid muscles exposed. The illustration also shows the lower part of the parotid gland removed, the facial artery standing up free in the pharynx and the posterior belly of the digastric muscle sutured to the sternomastoid to wall off the carotid triangle from the pharynx. If, before suturing these two muscles, the space between them has any depth, it should be drained by a separate stab wound through the skin.

not ordinarily removed, but the sternomastoid is somewhat freed so that it can be sutured over these to the digastric. If one invades the carotid triangle at this time, it is apt to complicate and unduly prolong the operation Before closing the external wound a large catheter is passed through one nostril into the pharynx and fastened by a strip of adhesive plaster one-half inch wide, to the upper lip. After the excision, the larynx drops very low and unless this catheter is guided by a finger in the pharynx, it is apt to enter the glottis. The external wound is closed without drainage by silkworm-gut mattress sutures that insure deep approximation of the skin and platysma. The cut or burned surface of the parotid should not be included in the approximation, as the secretion causes induration and suppuration. The floor of the mouth and all other raw surfaces are covered with a pack of broad strips of iodoform gauze into which balsam of Peru is thoroughly incorporated, this pack to be left in place several days and then renewed as necessary until the sloughs separate. This will entirely control all odors from the decomposing sloughs.

Postoperative treatment. The patient is put to bed in a semi-sitting posture. Proctoclysis is instituted and fluids given through the nasal tube as soon as tolerated. Frequent inhalations of benzoin steam and small doses of iodides to loosen secretions are given when necessary and morphine as needed.

The tracheal tube is retained until danger of œdema or of respiratory interference from

the packs is passed; before removing the tube a cork is placed in it for 24 hours. Usually after 10 days the patient can make very effective efforts to swallow but only water should be given until one can be sure that no fluid enters the glottis, at which time the nasal feeding tube can be removed.

After 6 weeks a very intelligible speech is usually developed but the rapidity of the return of all these functions depends largely on the intelligence and industry of the patient. A physician from whom I removed the whole tongue and the muscles of the floor 5 years ago has been practising his profession all this time and his speech is so perfect that few people know he has had an operation in his mouth, though he told me his vocabulary has been reduced about 30 per cent.

This operation is to be followed later by the radical dissection of the lymph-bearing areas of both sides of the neck; a plan for doing this that fits in with the preceding operation will be presented in the future.

The operation presented can be modified in a number of ways and in its present form is the outcome of several plans having in common the suprahyoid approach and the removal of the tumor, the muscles of the floor, and the upper lymphatics in one block.

The first operations were done in 1913 for cases of ulcer of the floor, tongue and jaw and at this time the body of the mandible was included in the excision; now I believe that thorough cauterization of the invaded bone with a soldering iron or Percy cautery is as curative, and besides the better functional results, is a safer operation. If the cauterization of bone is too prolonged the latter may be killed through the full thickness and no regeneration occur. I have had this experience. In one instance the hyoid bone and epiglottis were included in the excision. In this case persistent œdema of the glottis greatly retarded recovery of function.

This operation might be done on one side only but I have not seen a case in which I thought it indicated that I did not believe the most radical removal was necessary.

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ACUTE EMPYEMA OF THORAX TREATED BY MINOR INTERCOSTAL THORACOTOMY

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An analysis of the cases of empyema treated at Mount Sinai Hospital during a period of ten years (1903–1913) was reported by Wilensky. Thoracotomy with rib resection was the operation of choice, drainage being established with two large rubber tubes, and the dressings being changed as often as the amount of discharge required. Of 258 cases of acute empyema treated thus, 59 died, a mortality of 23 per cent. Fifty cases were not cured by the primary operation, i.e., 20 per cent of all cases. Cures resulting from the primary operation amounted to 57 per cent of cases.

The chief source of dissatisfaction was the fact that those not cured by the operation were destined to a long period of ill health, to a long period of after-care in the dispensary, to repeated secondary operations frequently increasing in extent, severity and risk, and often terminating in one or another type of deforming thoracoplastic collapsing operation. Not a few succumbed to these procedures, and of those who subsequently left the hospital "well," we did not know how many were restored to former health and usefulness. Other sources of dissatisfaction were the following: The patients were often very uncomfortable as a result of the necessarily bulky dressings, the maceration and infection of the skin due to the discharges, the free communication of the pleural cavity with the outer air (in spite of attempted occlusive dressings), and the necessarily frequent changes of dressings and tubes. The empyema cases were regarded as a nuisance in the wards. The dressings, saturated with pus, produced foul odors which disgusted the patients, and caused anorexia, an exceedingly unfavorable symptom in these cases. The quantity of dressings used was a source of considerable expense to the hospital.

To obtain better final results in empyema of the thorax, to prevent persistent sinuses and cavities, and fixation of the lung in an unfavorable position, Dr. Lilienthal proposed the operation of major intercostal thoracotomy. The principle was that of a free, wide exploration and thorough mobilization of the lung. When the condition of the patient rendered the operation inadvisable as a primary procedure, a small intercostal incision was made and a single tube inserted. In a few days or a few weeks the larger procedure was undertaken, if deemed necessary.

When rib resection for thoracotomy was in vogue, intercostal incision was reserved for those empyema patients who were desperately ill, in whom it was advisable merely to relieve the intrathoracic pressure symptoms. The mortality was consequently very high, Wilensky's statistics showing 11 deaths in 21 cases. It was noted, however, that those who survived gave practically no trouble in their after-treatment. They healed kindly and rapidly. When the operation of major intercostal thoracotomy was first introduced, simple intercostal drainage was likewise an operation of necessity and a preliminary to the radical procedure. In the series of 23 cases reported by Lilienthal in 1915, only 3 were done in two stages, while of the larger series reported in 1917, one-third was done in two stages. At the same time 38 cases were treated by minor thoracotomy alone with the low mortality of 18.4 per cent and excellent final results. Gradually more and more cases of acute empyema were treated by minor thoracotomy and the operation came to be one of choice instead of that of necessity.

The present report deals with 71 cases of acute empyema treated by intercostal incision during a period of 15 months (January 1, 1918, to April 1, 1919) on the surgical services of Drs. Lilienthal, Berg, and Beer.[1]

[1] For a period of three months when a considerable number of empyemas occurred after the recent influenza epidemic, Dr. A. A. Berg, who was then in charge of the three services, permitted me to supervise all the empyema cases on his service.

It was the practice in all cases except those of immediate urgency to have a roentgen examination of the chest before operation, and preferably before exploratory aspiration. It was deemed inadvisable to perform aspiration before the X-ray examination as this occasionally admitted air into the pleural cavity and confused the picture. Many of the patients had been aspirated before coming into the hospital, and two of these had submuscular abscesses as a result of leakage along the needle track, i.e., induced empyema necessitatis.

The X-ray examination with the patient in an upright position in cases of intrathoracic suppuration is often of great value, and should precede aspiration, if feasible. It informs us of the condition of the apparently uninvolved side, revealing at times an undetected pneumonia or a small effusion. It may show the presence of air as well as fluid in the chest, indicating communication with the bronchial system, due to rupture of a suppurative focus in the lung into the pleural cavity. Cases of this type, with bronchial fistula, form a separate group both as to prognosis and treatment. The examination may show one or more distinctly encapsulated or sacculated collections of fluid, and these form a third group of cases as regards treatment. At times when the physical signs suggest fluid and even when exploratory aspiration has yielded a few cubic centimeters of exudate, the X-ray reveals pneumonia or perhaps lung abscess.[1]

In seven cases the fluid aspirated prior to operation was not macroscopically purulent, although examination showed pus cells and bacteria, and cultures yielded a growth. These were treated by preliminary Potain aspiration. The toxic and septic phenomena in these cases were believed due to the underlying concomitant pneumonia. Our past experience coinciding with that of the military surgeons during the pneumonia epidemics in the mobilization camps, induced us to allow the patient to overcome his pneumonic infection, meanwhile relieving the intrathoracic pressure effects by aspiration of the fluid, as often as necessary. These cases later developed frank purulent fluid, but by the time this occurred the general condition was greatly improved, the temperature much lower, or even normal, and the outlook more favorable for recovery after the drainage operation. Adhesions had formed, and acute pneumothorax was avoided. One of these patients died, the others made a smooth recovery after minor thoracotomy.

[1] If the clinical course plus the roentgen findings make the diagnosis of lung abscess reasonably certain, it is well to postpone aspiration, if this be deemed necessary, until just before the contemplated operation. Aspiration through the indurated lung tissue permits leakage along the needle track and may cause virulent empyema or phlegmon of the chest wall.

TECHNIQUE OF OPERATION

The patients being in the hospital, the operation was performed in the operating room, but the procedure is so simple and requires so few instruments that if necessary, the patient need not be moved from his bed. Of the 71 cases, 32 were done with local anæsthesia, 26 under ether, 5 under gas and oxygen, 2 under chloroform, 6 not recorded. Local anæsthesia was used for children as well as adults. It would seem desirable to avoid ether in all cases such as these in which the lungs are or have recently been the site of a pneumonia. In addition to the usual infiltration with 0.5 per cent novocaine along the line of incision, an effort was made by some operators to block the intercostal nerves by infiltrating at the borders of the ribs bounding the intercostal space at a point posterior to the line of incision. This was found to lessen considerably the pain of entering the pleura and the discomfort of introducing the drainage tube.

It was our aim to drain the chest at the lowest possible point. Aspiration was made in the posterior axillary line through the eighth space, at times the ninth space. In a few cases, pus was found in the axilla and drainage was performed there. The pus having been located at its dependent point, the needle was left *in situ* and marked the center of a 1.5 inch incision which was carried down to muscle layers. A grooved director was passed along the needle and the latter withdrawn. A dressing forceps was now passed along the groove and the pleural opening spread sufficiently to permit introduction of a tube of suitable diameter (1.0 to

1.5 centimeters), held in the grasp of a long artery forceps, and provided with a side hole about an inch from its end. The muscle fibers not being cut acted somewhat as a sphincter would, surrounded the tube closely, and made for an air-tight drainage. The tube was introduced so that the fenestra was just within the pleura, part of the pus was allowed to escape and then it was clamped. The superficial wound was lightly packed, the tube secured by a safety pin and adhesive strips to the skin, and a small dressing applied over the whole. The patient was then placed in the special bed for empyema cases designed by Dr. Roth.

In two cases, young infants, drainage was established by inserting, under local anæsthesia, a trocar and cannula, threading a tube through the cannula, and withdrawing the latter, leaving the tube in place.

POSTOPERATIVE TREATMENT

This was greatly facilitated by the employment, in children, of the empyema bed devised by Irving R. Roth and in use since August, 1917. The child lies on the affected side on a canvas spanned across the bed frame, the drainage tube passing through a window in the canvas to an air-tight pus-collecting bottle. The air is exhausted from the latter by means of a partial vacuum produced by gravity in a large irrigating bottle, from the bottom spout of which water is allowed to flow into a plain receiving bottle.

By means of this device the pus is collected in a bottle, no soiling of dressings, linens, etc., occurs, and the skin is entirely free of irritating discharges. The forces of gravity and negative pressure are applied to keep the chest empty of pus and to favor pulmonary expansion. The amount and character of the discharge are readily observed. The same method of drainage is applied to adults by allowing the thoracic drainage tube to pass to the pus bottle between the two sections of a transversely split mattress.

The drainage tube is changed and the wound dressed every three or four days. In cases in which there are large amounts of fibrin in the discharge the drainage tube and the dressing must be changed oftener.

The guides to the progress of the case consist in the following: first, the clinical course of the patient, in whom we note decrease of temperature, of pulse and respiratory rate, increase of appetite, improved sleep and comfort, a brighter, more cheerful aspect (in short a disappearance of the septic phenomena); second, decrease in amount and change in character of the discharge, a reduction to about 4 drams of serous fluid per day warranting discontinuing the apparatus; third, fluoroscopic and radiographic evidence of expansion of the lung and absence of retention or sacculation.

Just as the roentgen examination is of much diagnostic value in empyema, of no less aid is it in the after-care of the case. Unexplained retrogressions with febrile course may be clarified by X-ray findings of sacculation and retention, pneumonia in the same or opposite lung, or abscess of the lung previously hidden by the fluid in the chest. The persistence of purulent discharge may be explained by the X-ray picture of a pneumothorax of greater or lesser degree with fixation of the lung by a dense membrane. Here the fluoroscopic data are of value in prognosis and therapy. If such examination shows any expansion of the lung when the patient coughs or strains, a conservative course is indicated. In these cases persistence in drainage and efforts at disinfection may result in aseptic healing of the wound and a gradual obliteration of the dead space by pulmonary expansion together with some contraction of the thoracic walls.

If, however, the lung is found persistently fixed in an unfavorable position and incompletely expanded, we believe that operative interference is indicated, and our preference is for the procedure of major intercostal thoracotomy, which aims to mobilize the lung. Although disinfection of such cavities is attainable, and closure of the wound takes place (we agree with Moschcowitz in not employing secondary suture), dead spaces of this kind frequently become reinfected and open of their own accord or require secondary drainage. We distinguish, therefore, between

pneumothorax which tends to obliteration, and pneumothorax which repeated examination shows to be constant. We have not had sufficient evidence to corroborate the belief that Dakin's fluid will dissolve the limiting membrane and accomplish mobilization in the latter group of cases. Microscopic examination of such membranes in a few cases treated by major thoracotomy showed them to be organized connective-tissue structures and not fibrinopurulent exudates.

The use of Dakin's fluid was added to the method of drainage described by inserting a T-tube between the thoracic drain and the pus-collecting bottle. The reservoir for the antiseptic was connected to the side-arm of the T-tube and the fluid in varying amounts (25 to 100 cubic centimeters), allowed to enter the chest every two hours (in some cases every hour) by day, and twice during the night. The suction was suspended for 15 minutes by clamping the tube connecting the glass T with the pus bottle, and then resumed until the time for the next instillation of Dakin's fluid. Caution was observed in using the fluid, the first instillation being made slowly with a syringe containing 10 or 15 cubic centimeters. While we were usually aware of the presence of a pleuropulmonary fistula, at times our first definite knowledge had come when instillation of the fluid by the nurse produced violent cough, cyanosis and acute distress, the patient later stating that he tasted the chlorine and felt as though he were being strangled. The appearance of blood in the discharge, not ascribable to trauma of dressing, was considered an indication to stop the use of Dakin's fluid, as serious bleeding had been reported in some cases.

The solution kept the discharges thin and limpid and prevented clogging of the drain, which, nevertheless, was changed daily while disinfection was being practiced. At times when the suction apparatus was discontinued a single short Carrel tube was inserted in the sinus and the fluid instilled through this. A comparison of the results in cases treated with and without Dakin's fluid showed no more rapid healing in the former.

RESULTS OF USING DAKIN'S SOLUTION

Treated with Dakin's

Cases	23 (8 adults)
Hospital stay	43 days (18 to 91)
Suction drainage renewed	4 cases

Treated without Dakin's

Cases	28 (10 adults)
Hospital stay	39 days (16 to 74)
Suction drainage renewed	3 cases

I feel certain, however, that our organization, necessitating changing of nurses and of ward doctors at rather frequent intervals, did not lend itself to ideal application of disinfecting methods in all cases in which it was attempted.

When the amount and character of the discharge or the microscopic examination of the pus (absence of bacteria) indicated that the infection was controlled, and the roentgenographic studies indicated favorable physical conditions within the thorax, the apparatus was discontinued, a small tube inserted just to the pleural cavity and the patient encouraged to be up and about. In a few days the tube was removed and the wound allowed to heal. In eight cases it was necessary to renew the suction drainage for an additional period because of recurrence of infection and retention.

Certain adjuvants were found of value in treating these patients:

First, an effort was made to maintain the nutrition of the patient at a high level by extra feeding. Second, expansion of the lung was encouraged by having the patient use blowing bottles. Dr. Lilienthal had the children use toy balloons to the mouth piece of which a constricted rubber tube was attached, thereby enforcing increased respiratory efforts. Third, as far as facilities permitted, exposure to fresh air and sunshine was employed and in some very serious cases this seemed to be a determining factor in recovery of the patient.

Analysis of the data derivable from the 71 cases studied may be best presented as follows:

Causation. Reliance had to be placed mostly on the history of the case, as the patients had usually been treated at home for their preceding illnesses.

Scarlet fever..... 1[1]
Primary (?)..... 4
Pneumonia..... 66
(20 of which were postinfluenzal)

Sex
Males, 38; deaths, 8.
Females, 33; deaths, 5.

Side incised
Right, 39; deaths, 9.
Left, 31; deaths, 4.
Bilateral, 1; deaths, 0.

Bacteriology
Sterile, 5 (3 showed organisms in spreads); deaths, 0.
Streptococcus hæmolyticus, 20; deaths, 4.
Streptococcus anhæmolyticus, 2; deaths, 1.
Pneumococcus, 18 (I, 3; II, 4; III, 1; IV, 8); deaths, 3.
Staphylococcus aureus, 9; deaths, 3.
Staphylococcus aureus and pneumococcus, 1; deaths, 0.
Not reported, 16; deaths, 2.

Age and Results

Under 1 year	6	2	4	0
1 to 2 years	11	5	6	0
2 to 3 years	9	2	7	0
3 to 5 years	6	1	5	0
5 to 10 years	17	1	12	4
10 to 20 years	9	0	7	2
20 to 30 years	7	1	5	1
30 to 40 years	4	0	4	0
40 to 50 years	0	0	0	0
50 to 60 years	2	1	1	0
	71	13	51	7

Youngest, 14 weeks, cured.
Oldest, 60 years, died.

[1] This child, whose empyema followed scarlet fever, went through diphtheria and measles with his chest undrained.

RESULTS COMPARED TO SERIES TREATED BY RIB RESECTION

Intercostal incision:
Cases..... 71
Deaths..... 13, or 18 per cent
Cured..... 51, or 72 per cent
Not cured..... 7, or 10 per cent

Rib resection:
Cases..... 258
Deaths..... 59, or 23 per cent
Cured..... 149, or 57 per cent
Not cured..... 50, or 20 per cent

It is true that the present series of cases amounts to only one-quarter of those treated by rib resection in former years, but cases treated by intercostal drainage in Lilienthal's report of 1917, showed a mortality of only 18 per cent also. We have, therefore, a decrease in mortality of 5 per cent, a decrease in cases requiring secondary operation of 10 per cent, and an increase of cures by the primary operation of 15 per cent. Aside from these advantages are those which cannot be expressed in figures, namely, the greater comfort of the patient, the cleanliness of the method, the improved morale of the patients on the ward, the saving in time, labor, and material in the after-care of the cases.

The procedure of minor intercostal thoracotomy surely eliminates one factor in the production of persistent sinuses after empyema, namely, infection of the resected rib. In 89 cases of chronic empyema analyzed by Wilensky, 6 were attributable to disease of the ribs, and in the series of acute empyemas osteomyelitis occurred 4 times. This incidence is relatively low. Petit, for example, reports 16 cases of persistent empyema sinus in 12 of which disease of the previously resected rib was present. Tuffier likewise notes the frequency of osseous infections following rib resection. It seems reasonable to believe that disease of the rib can delay healing not only by necessitating sequestration, but by reinfection of the empyema cavity as well from the focus in the chest wall.

In one case treated by minor thoracotomy pressure of the tube caused denudation of the periosteum of the ribs, but this covered over when the tube was removed, and healing took place.

Hospital stay. The 51 cases cured by intercostal drainage alone remained in the hospital from 16 to 91 days, the average being 41 days.

Of these cases 29 were completely healed when discharged, 19 cases required from one to four superficial dressings in the dispensary, 2 cases were dressed twice a week for 4 weeks, and 1 was dressed at another hospital dispensary for 3 months. This patient said that at no time was there much discharge, and at no time was a tube inserted, the reason for the tardy healing of the sinus not being apparent.

Mortality. Of the 13 patients who died, 11 were children. Two cases, desperately ill and intensely cyanotic, ceased within an hour after operation. Three cases had diffuse bronchopneumonia, 3 had pneumonia on the same side, and 2 on the opposite side. Otitis media was noted in 3 cases; furunculosis, impetigo, and purpura once each. One man of 60 was doing fairly well and out of bed, when he was stricken with hemiplegia and died.

COMPLICATIONS

	Deaths	Cured	Not Cured
Pneumonia			
Same side	3	5	0
Opposite side	2	1	0
Bronchopneumonia	3	0	1
Otitis media	3	4	1
Cerebral complications			
Hemiparesis	0	1	0
Hemiplegia	1	1	0
Skin lesions			
Furunculosis	1	1	0
Impetigo.....same case	1	0	0
Purpura (also had bronchopneumonia)	1	0	0
Subcutaneous abscesses	0	2	0
Measles	0	2	0
Diphtheria	0	5	0
Pregnancy	0	1	0
Eroded rib	0	1	0
Bronchial fistula	0	2	0
Persistent sinus	0	0	2
Persistent pneumothorax (also had pneumonia)	2	0	5

Cases not cured by primary operation. Five cases showed a persistent pneumothorax, 4 having been treated with Dakin's solution after the primary operation. Three of these were cured of this condition by major intercostal thoracotomy. One was cured by resection of large segments of two ribs, and mobilization of the lung through this wound. One case was discharged uncured, the patient refusing radical operation.

Two cases had persistent sinuses the cause of which was not clear from our records. One, a child, was not brought back for study, though the mother was directed to do so. The record of the other case was incomplete, but cure was apparently not effected.

Sacculated empyema. Strictly speaking all empyemas are encapsulated, for only in the earliest stage is the fluid free in the pleural cavity. It becomes walled off by adhesions as the purulent stage supervenes. Well-defined sacculations may occur either as the result of incomplete resolution of a general pleuritis or as the result of an originally localized pleuritis. Such sacculations occur most often in the axilla, frequently high up over the upper lobe. Next in frequency are collections of pus postero-internal to the lung, occupying the concavity formed by the vertebræ and the ribs mesial to their angles, but sometimes extending out to the posterior or midaxillary line. Other, more unusual sites are the anterior aspect of the lung, between the lung and the parietal pleura covering the structures of the middle and anterior mediastinum, between the base of the lung and the diaphragm, and between the lobes of the lung. True interlobar empyema is uncommon.

The treatment of these cases must vary with the individual conditions. Large encapsulated empyema, usually behind the lung, presents a clinical course similar to that of ordinary empyema and may be treated in the same way, namely, by minor intercostal thoracotomy at the most dependent point. Small solitary pleural abscess is insidious in its onset, symptomatology and clinical course. When diagnosticated, it has usually been in existence for some time, its limiting walls are dense and unyielding. It is best treated by resection of a portion of the rib corresponding to its most dependent point. Discission of the visceral pleura may be of assistance in hastening obliteration of the cavity. When two distinct pleural abscesses exist it is questionable whether each should be drained separately, or whether major thoracotomy should be resorted to, using suction apparatus to minimize soiling of the general pleural cavity, and mobilizing the lung so as to accomplish rapid obliteration of the cavities. When it is possible by roentgen examination and exploratory aspirations (different types of fluid being withdrawn) to determine that the empyema is multilocular, a wide exposure is desirable, permitting emptying of all the locules, breaking down of the adhesions separating them, and mobilization of the lung.

The series of cases discussed in this paper include only two sacculated empyemas, treated by minor thoracotomy.

Bronchial fistula. The presence of a communication of the bronchial system with the pleural cavity indicates that a suppurative focus in the lung, a smaller or larger abscess, has caused the infection of the pleural cavity. This rupture of the focus produces a pyopneumothorax. These patients are usually very ill, dyspnœic, cyanotic, anxious, with rapid pulse and marked febrile course. They sit up in bed and cannot be persuaded to lie down. Operation should be done as soon as possible

with local anæsthesia, the patient sitting up. To turn the patient on his healthy side is to invite a gush of pus from the trachea, and with general anæsthesia, an almost certain aspiration pneumonia on the opposite side. Although two cases of bronchial fistula were treated with good result by minor thoracotomy, drainage by resection of part of a rib with its periosteum is preferable. A wide thoracic opening is of advantage because adequate drainage must be maintained until the fistula heals. It is of no disadvantage because the lung cannot expand until the fistula has closed, and most fistulæ close spontaneously. Intercostal incision does not serve well because the thorax, in these cases, undergoes rapid contraction, the ribs crowd together, and drainage is interfered with.

Not infrequently a small fistula is present which is not discovered until after operation. Failure of the lung to expand properly should lead one to suspect this. A tightly fitting tube leading from the empyema cavity into a dish of sterile water will help in deciding the point. If a fistula is present forceful expiration will cause a stream of air bubbles to issue from the tube. If there is no fistula, some bubbles will come through until the next inspiration, when they cease to appear and water is drawn up through the tube into the chest. At times the injection of bismuth paste will be followed by expectoration of some of the injected substance. The use of Dakin's solution not infrequently reveals the presence of a fistula, patients with this condition tasting the solution (i.e., the chlorine gas liberated) when small amounts are used, and presenting at times rather alarming symptoms when large amounts are used.

CONCLUSION

The proper treatment of empyema requires close co-operation of the internist, the surgeon, and the roentgenologist. For purposes of prognosis and treatment empyemas may be best divided into ordinary empyema, pyopneumothorax, and sacculated empyema. Cases due to specific infections, such as tuberculosis and actinomycosis, should not be grouped with those caused by the ordinary pyogenic organisms.

We may fairly conclude from the cases analyzed that simple intercostal thoracotomy with the method of drainage described has yielded results superior to those obtained by rib resection. It can almost always be done with local anæsthesia; it is a simpler procedure; it makes for the comfort of both the patient and his attendants. By making possible the early use of suction drainage, it favors pulmonary expansion. It eliminates one source of chronic empyema sinuses, namely, disease of the ribs. Rib resection and major thoracotomy are to be reserved as primary procedures for specific indications. The deforming thoracoplastic operations previously practiced have been eliminated.

I am greatly indebted to Doctors Lilienthal, Berg, and Beer for the use of the case histories, to Dr. Berg for the opportunity to care for a considerable number of the cases throughout their course, and to my chief, Dr. Lilienthal, for much valuable instruction and suggestion.

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THE OPERATIVE TREATMENT OF ADVANCED PULMONARY TUBERCULOSIS[1]

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IT is generally recognized today that the therapeutic pneumothorax (Forlanini–Murphy) is of great assistance in the treatment of pulmonary tuberculosis. When it is combined with proper hygienic measures and with a régime carefully supervized by the internist or specialist, it has been found that tuberculous patients get entirely well under such treatment; that others are improved sufficiently to enable them to lead a satisfactory existence for many years.

But what if adhesions have united the pulmonary to the costal pleura, if the needle again and again fails to find a place in which the nitrogen (or pure air) can be blown in successfully; if, further, all the other measures of scientific régime do not bring improvement? Were no other treatment at hand in such a contingency these patients would be doomed. Their death would be a question of but a short time.

It is in such desperate cases and at this stage of the disease, that modern operative surgery is found of value.

At the suggestion of Brauer, then the internist at the Marburg University, the late P. L. Friedrich, then director of the surgical clinic of the same University, took up this question with Brauer in 1908. They reasoned that when the presence of far-reaching adhesions between the two pleural leaves prevents the insufflation of the pleural sac, it should be possible to accomplish the required collapse and artificial putting at rest of the diseased lung by an attack upon the skeleton of the thorax. They further argued that the collapse of the chest wall, which would follow the resection of the tenth to second or first ribs inclusive if followed by artificial mechanical compression of the thorax should produce in these otherwise hopeless cases the same final result as the Forlanini–Murphy method in the more favorable cases. Friedrich thereupon proceded to operate on the basis of this theory, resecting the ribs above mentioned, after having gained the necessary access to the bony thoracic wall by means of Schede's incision (Fig.1). The work was done in one sitting under superficial morphine-chloroform anæsthesia. Friedrich called this operation: "Total thoracoplastic pleuropneumolysis," and considered it indicated in one-sided tuberculous affection of the lung in patients who had not yet passed the fortieth year, particularly if there was cavity formation in the upper lobe. Simultaneous, non-active and non-progressive involvement of the other lung did, in his opinion, not represent a contra-indication.

In his address before the International Surgical Congress at Brussels, 1911, Friedrich was able to report 28 cases thus operated upon with 19 recoveries. Of the latter 16 were greatly improved; 3 improved. All were desperate cases, in fact three-fourths of them were apparently beyond help as far as any other treatment was concerned.

In view of the risk involved in undertaking so serious an operation in these always weak and greatly reduced patients, Friedrich's then first assistant, F. Sauerbruch, tried to modify and simplify the Brauer-Friedrich procedure by doing it in stages and under regional and local novocaine anæsthesia. In order to avoid aspiration pneumonia of the lower lobe, from a purulent cavity in the upper lobe, Sauerbruch proceded thus: he resected the tenth to sixth ribs inclusive and compressed the thorax by means of pad and elastic straps, and 2 to 3 weeks later, added the removal of sufficiently large pieces of the fifth to second or first ribs inclusive. The first rib was rarely resected. Sauerbruch found that the posterior half of the Schede incision exposed a sufficient length of the ribs for resection (hook-incision, Figs. 2 and 3). He adopted the term "extrapleural thoracoplasty," which Spengler had coined in 1910,

[1] Read before the second annual meeting of the American Association for Thoracic Surgery, Atlantic City, June 9, 1919.

Fig. 1. Schede's incision raising a skin muscle flap including scapula, exposing the entire length of the first to tenth ribs.

for far-reaching rib resection in cases of cavernous phthisis.

Of 41 patients of Sauerbruch[1] thus operated upon 8 were cured; 7 much improved; 13 improved; 3 remained unchanged; 4 became worse; 6 died, of the latter one in immediate connection with the operation; 5 died later on. Of the 20 improved and much improved 7 gave hope for complete recovery. The last results of Sauerbruch published by his first assistant, C. Henschen, are remarkable. The number of his uncomplicated cases had risen to 122, of whom 24 were cured, 30 considerably improved, 32 improved, 4 unchanged or worse.

The cases had all been carefully selected by specialists in tuberculosis. The majority of them came down to Zurich from Davos in Switzerland and returned to the higher altitudes after their operative recovery. As a general rule, only cases with unilateral affection were considered, although *slight* affection of the opposite lung and early tuberculous involvement of the larynx, did not exclude the patient from the operation. The presence of ulcerous intestinal tuberculosis, also of recent foci in the lower lobe of the other lung, and of old foci in the region of the hilum of the opposite side, and as well advanced debility were considered contra-indications.

Sauerbruch succeeded in doing the operation, with his trained set of permanent assistants, from the first incision to the finishing of the last layer suture, in 17 to 19 minutes, a brilliant demonstration of the efficiency of "crew work," as could be witnessed by members of the Southern Surgical Club whose itinerary for the United States and Europe in the summer of 1914 took them also to Zurich.

With increasing experience, Sauerbruch undertook to do the entire rib resection (tenth to second ribs inclusive) in one and the same sitting, when conditions seemed to warrant it. If stronger compression of the lung than obtainable by the described procedure was required for the accomplishment of the desired result, viz., subsidence of fever, reduction of sputum and cough, improvement of the patient's general condition, the following additional steps were taken:

a. Resection of the first rib at the front also of a portion of the clavicle.

b. Resection of the phrenic nerve at the neck (phrenicotomy), to induce permanent paralysis of the respective half of the diaphragm on the diseased side.

c. Tuffier's operation: "apicolysis" with insertion of a plomb. The operation consists in the resection of a short piece of the second or third rib in the preaxillary line, with division of the posterior periosteal envelope of the rib, and collapsing the apex of the lung by separating the parietal plus adherent visceral pleura from the intrathoracic fascia. The resulting free space is then filled up with fat or paraffine. Tuffier preferred the fat-transplant, usually choosing a piece of omentum which he had learned to keep undecomposed in cold storage for the desired length of time.

[1] Ergeb. d. inn. Med., 1913, x.

Fig. 2 (at left). Sauerbruch's "hook incision," representing the posterior half of Schede's incision.

Fig. 3. Exposure of the posterior two-thirds of the ribs by means of the "hook incision," the inner border of the scapula being pulled outwardly.

Sauerbruch made use of the paraffine-plomb, as suggested by Baer of Davos. Paraffine of a higher melting point than the temperature of the body, is put into the cavity in small, round lumps while still moldable; there it soon hardens and forms a large, irregularly shaped, coherent mass which, when healed in, represents a permanent reliable compressorium of the collapsed apex. In 1913, Sauerbruch reported 8 operations of this kind, of which 6 were successes, and 1 improved. Up to the spring of 1914 the plugging had been carried out at his clinic in 23 patients.

Wilms, of Heidelberg, did not fear aspiration pneumonia in the lower lobe as a result of multiple rib resection in the presence of a cavity in the superior lobe, at least not in the milder cases. He favored what he termed "columnar resection" of the upper 7 or 9 ribs, anteriorly and posteriorly in one sitting (Fig. 4). The intermediate portion of the ribs, which is left in place, is utilized for the compression of the lung. Wilms also employed regional and local anæsthesia. He reports 12 cases without mortality and with satisfactory results. Sauerbruch considers it advisable to use this procedure only in non-cavernous tuberculous affection of the upper lobe.

The cases reported by these three authors constitute the largest series of its kind so far published. It is interesting to note that their operative results are almost identical: two-thirds (or more) of the patients were either cured or improved,—certainly a remarkable record.

Sauerbruch also led the way in employing the same procedure—subsequent to ligation of branches of the pulmonary artery—for the treatment of bronchiectasis, and as, for reasons which will appear below, it is only in that type of cases that, until very recently, I personally have been able to do thoracoplasty, I beg leave to be permitted to deviate for a moment to the discussion of the treatment of bronchiectasis.

I have done extrathoracic thoracoplasty in advanced bronchiectatics seven times in the course of the last ten years. For this class of cases the operation represents but one of the many "conservative" procedures which have

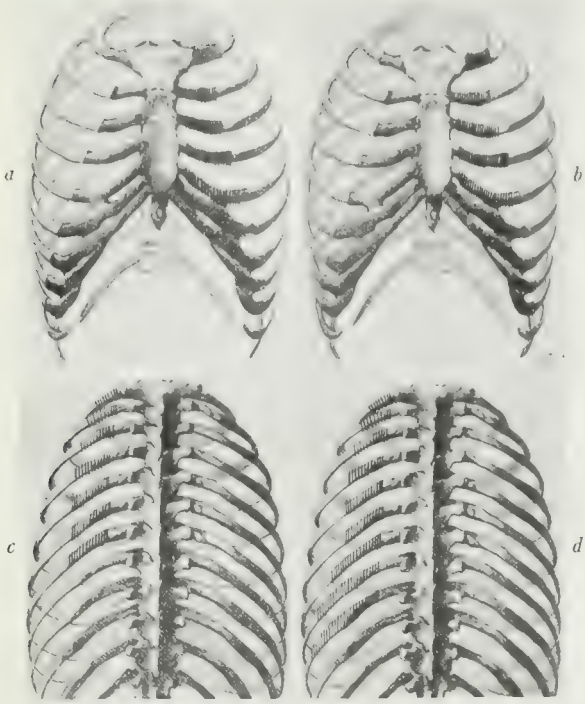

Fig. 4 *a–d*. Illustrating Wilms' "columnar resection" of the ribs. *a*. Resection of the cartilages plus adjacent portions of the upper five ribs, also of the sternal extremity of the clavicle, in order to increase the contemplated compression of the diseased lung. *b*. Same as *a*, without the additional operation on the clavicle. *c*. Resection of the upper seven ribs in the region of their angle. *d*. Same as *c*, operation involving the nine upper ribs. Note the increasing length of the resected portion of seventh to ninth ribs. (From *Muenchener medizinische Wochenschrift*, 1913, p. 450-451.)

Fig. 5. Transverse cut through dorsal spine with muscles of back. The needle has been added by author in order to point to the efficiency of this regional anæsthesia if the method is carried out correctly. (From *Spalteholz, Handatlas der Anatomie des Menschen*, vol. iii, Fig. 690.)

been proposed for the surgical treatment of these unfortunates.

It was the above-mentioned late Prof. Friedrich who, at the time of his visit to our country, in 1909, counseled me to practise conservatism in treating surgically patients suffering from advanced bronchiectasis. He was of the opinion that the less dangerous operations should be tried before resorting to lobectomy. He was afraid that the youngest and last child of operative surgery, "thoracic surgery," might not gain the confidence of our medical confrères and of the general public, if too many deaths were reported as a result of a too aggressive surgery.

I took his advice, and performed a number of these conservative operations for bronchiectasis. Today I look back upon this series of bronchiectatic operations partly with regret and partly with satisfaction; with regret, because I failed to cure a number of advanced cases who might have had a better chance with properly performed lobectomy; with satisfaction, because I succeeded by patience and perseverance in saving, even curing a few greatly reduced patients, who would most likely have succumbed to more radical work. My experience has led me to believe that even quite advanced cases of bronchiectasis can be very greatly improved by operations less dangerous than lobectomy. At the present moment most careful individualization in establishing the indication for operation is required in this class of cases. However, there can be no doubt that in the very advanced stage of bronchiectatic affection, *only the extirpation* of the diseased lobe or lobes of the lung, lobectomy, can bring permanent relief.

Looking back, a further source of satisfaction in prolonged conservative operative work in this branch of thoracic surgery has been to me, that I have made early acquaintance with extrapleural thoracoplasty, done under regional and local anæsthesia. As stated before, I performed this operation seven times in these patients, in a few instances

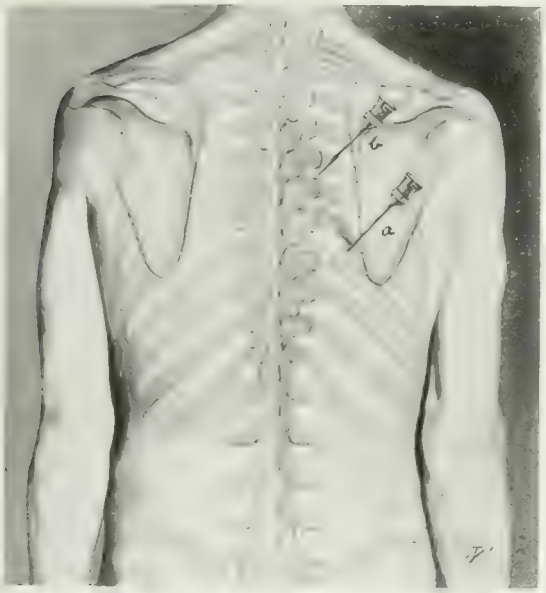

Fig. 6. Diagrammatic illustration of the location where the needle is introduced in Schumacher's, *a*, and Kappis', *b*, methods. In practice the needle at *a* has to point upward and inward and run close to the rib.

resecting all the upper ribs, from the tenth to the first inclusive, in one sitting. During the entire course of some of these operations I could converse with the non-narcotized patients.

It was but natural that I was eager to try to save by extrapleural thoracoplasty also suitable patients with advanced tuberculous affection of the lung, in whom therapeutic pneumothorax was not feasible. However, for many years past, insurmountable obstacles presented themselves. Thanks to the high state of education of the public in matters tuberculous, and thanks further, to most stringent rules of the health authorities, patients with active tubercle bacilli in their sputum are refused admission to the public wards of our hospitals, and the boards of trustees likewise refuse their admission to the private division. For more than seven years I have vainly tried to get these cases admitted to isolated parts of the hospitals with which I am connected. The war prevented the carrying out of promised arrangements in the thoracic pavilion of the Lenox Hill Hospital.

Fig. 7. The same with the patient in the abdominal posture, lying horizontally on the operating table. (In the picture the table has been tilted in order to allow the artist to photograph the entrance of the needle in the back.)

It is necessary to have these patients operated upon in a place where the surgeon is in easy reach and where the patient can be under the continuous attendance of trained nurses, for, next to careful aseptic work under regional and local anæsthesia, the success of the operation depends largely on most vigilant and efficient nursing and constant intelligent supervision of the patient during the first few days after the operation.

Some months ago the subject was taken up again before a meeting of the Board of Trustees of the Lenox Hill Hospital, and after a lengthy discussion permission was obtained for such patients to enter the isolating house. Fortunately, the superintendent gave me the use of a rather isolated room on the top floor of the hospital proper for the surgical treatment of these cases. Here my first patient, thus operated upon, recovered:

L. S., male, 26 years old; suffering from tuberculosis of the left lung for the last 7 years; has been residing, in chronological sequence, in Saranac Lake, Colorado, New Mexico, New York, and again in Saranac Lake. Tubercle bacilli were first found in 1914. He had repeated attacks of hæmoptysis in 1916 and 1917. The establishment of a therapeutic pneumothorax being found impossible on account of extensive adhesions, Drs. Baldwin and Trembley of Saranac Lake kindly sent him to me for operation. The patient appeared very delicate, was short of breath on slight exertion and had a rapid pulse. Every few weeks, following a slight chill, his temp-

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 8. Appearance of scar after first operation. Resection of tenth to sixth ribs.

Fig. 9. Compression pad in place covering dressing.
Fig. 10. Compression pad in place (rear view).

erature would rise to 103° and more, coming down to normal gradually. Clinically the left lung showed all the signs of far-reaching tuberculous infiltration with multiple cavity formation. Quantity of sputum, 60 cubic centimeters in 24 hours.

It was decided to take the safest course, as advised by Sauerbruch and do the rib resection in a two- or even three-stage operation. November 18, 1918, first stage. Regional and local novocaine-adrenalin anæsthesia (Kappis and Schumacher).[1] After infiltration of the desired line of incision, the Kappis method is carried out first (Figs. 5, 6, and 7), 2 cubic centimeters of the anæsthetizing solution being deposited after striking the rib with the needle, and 8 cubic centimeters around the posterior roots of the thoracic nerves near the spine. The Schumacher method in weak proportion, is then added (Fig. 6a), 5 cubic centimeters of the fluid being deposited at and below the angle of the tenth to sixth, inclusive, left ribs, 150 cubic centimeters of the solution in all. This combined course of anæsthetization was taken to insure greater success. After some temporizing, during which the patient was finally prepared for operation, the lower portion—about three-fourths—of the typical posterior hook incision was painlessly carried out (Fig. 2), the scapula pulled aside (Fig. 3), and pieces of bone, 10 to 15 centimeters long, excised well beyond the angle, from those ribs. With two long split drainage tubes in place, the wound was sutured in layers with a continuous stitch, and the dressing held in place by broad zinc adhesive plaster which also fixated the arm. The drainage tubes having been removed on the third day, the wound healed quickly by primary union. Thorax compression was made by means of a pad and elastic strips buckled to a ring surrounding shoulder- and hip-joint of the opposite side. Two weeks later the patient was out of bed, improved in every respect.

On December 5, it was considered timely to do the second stage on the fifth to second ribs, inclusive, again avoiding general anæsthesia (Fig. 11). Only a few drops of anæsthol, 20 cubic centimeters in all, were given, more to quiet the patient, than to alleviate the pain. But, in order to expose a sufficient length of the ribs it became necessary, at the second stage, to re-incise the entire length of the first cut. The regret felt at having to destroy the nice primary union (Fig. 8), suggested the thought of trying to do the required resection in one stage in the future, at least in patients not too greatly reduced. The stumps of the ribs resected at the first operation were found covered with glistening white connective tissue of remarkable thickness. Again, drainage and dressing were applied

[1] See Ann. Surg., 1917, lxvi, 404.

Fig. 11. Resected portions of second to tenth ribs.

as before. The patient made an uninterrupted recovery. He was out of bed on the sixteenth day. Compression was made with larger and smaller pad day and night (Figs. 9 and 10). Soon the sputum decreased in amount and the coughing spells became less frequent. The patient gradually gained in weight; the bacilli disappeared after the first operation and have not been found again.

Today the patient is greatly improved; he is back in the mountains. Under date of March 25, he reports continued good progress, increasing weight (128 pounds), pulse 60 to 70, temperature never above 100°, hardly any expectoration, and he feels pretty strong. On May 25, he writes: "Weight increased to 136 pounds; I feel fine." (The patient was presented before the meeting, Fig. 12.)

Considering the fact that this patient would have been hopelessly lost at an early date without operation, his present condition certainly is a source of great satisfaction.[1]

[1] Another much reduced male patient with advanced right-sided tuberculosis of the lung (cavity formation) came to me for operation through the courtesy of Dr. Robert C. Paterson of Saranac Lake, in December, 1918. He, too, had been sick for many years; he coughed a great deal, was desperate and demanded operation as a last resort. He clearly was a bad risk. Subsequent to the first stage of the extrapleural thoracoplasty he developed a continuously high and irregular fever, commencing on the third day after the operation. Paravertebral resection of the sixth to the tenth ribs inclusive had again been done by means of the hook incision under local novocaine anæsthesia; the operation was well borne. All attempts at improving his condition being without avail, the patient was, with Dr. Paterson's consent, brought back to the mountains, but died there soon after. Partial postmortem (Dr. Paterson) revealed a pronounced disseminated tuberculosis of the opposite, left, lung, less of the one on the operated side. Such dissemination has been found to be a rather rare occurrence after the plastic operation. It has to be looked upon as representing a sudden activation of hitherto quiescent foci, the sudden absorption of toxin during the first stage of collapse of the lung, causing a postoperative tuberculous reaction. It is an interesting fact that a hæmatogenous spread of the tubercle bacilli, with subsequent development of a general miliary tuberculosis has never been observed after "indirect" operation, neither after the establishment of a therapeutic pneumothorax nor after the extrapleural thoracoplasty, (Henschen loc. cit.).

Fig. 12. Scar as it appears today with resection of tenth to second ribs completed.

The immediate results of the far-reaching collapse and pronounced compression from all sides of the affected lung, are the following: Proliferation of connective tissue; gradual carnification of the elastic lung tissue and reduction in size of former cavities; onset of a chronic hyperæmia (according to Cloëtta's careful investigations), which, works in the sense of a Bier's hyperæmia and causes the tuberculous infiltration to be replaced by permanent scar tissue. Inactive foci of the opposite lung are often beneficially influenced by the operation.

Hand in hand with the local organic improvement, the subjective condition of the patient points to a steady change for the better. Cough and sputum become reduced or cease; bacilli disappear; fever and night sweats stop; the body-weight increases.

Thus hope, *well-founded hope*, may still be held out to a certain number of these patients who often have been battling bravely for years, and formerly could see no way out.

There can be no doubt that advanced and otherwise intractable pulmonary tuberculosis, particularly in cases of pronounced unilateral cavity formation, has become a distinct border-line disease, and that the operative surgery of today offers substantial hope of even a cure to many of these despairing patients.

RAPID EXPULSION OF THE PLACENTA

By Dr. GEORGE SKLAVOUNOS, Athens, Greece
Professor of Anatomy, University of Athens

IT is well known that two methods are employed to obtain rapid detachment of the placenta; the external, or Credé method, and the internal, or the intra-uterine use of the hand. All specialists in obstetrics agree that both of these methods cannot be used without a certain amount of danger, and this is especially true when practiced by unskilled hands. The weak point of the Credé method is that there is the danger of crushing the muscular coat of the uterus, thus provoking rupture in the further course of delivery of the placenta. The extirpation of the placenta by the hand is a violent procedure which can be employed without danger only by specialists and under strict aseptic precautions.

When I first saw the umbilical cord hanging from the orifice of the vagina in cases of retained placenta, I thought that in this way nature had given us a means of delivering the placenta without injuring the uterus. The idea immediately occurred to me to inject in the umbilical vein boiled water, which had been prepared for intra-uterine injection, to provoke the pains. Thus I hoped to excite the muscular coat more intensively and secondly to increase the weight of the placenta which would then be separated more easily. But I refrained from trying the procedure on the living as I wished to make some experiments first on expulsed placenta.

About the end of October, I injected into the omphalic vein a sufficient quantity of salt water to fill only the veins of the placenta up to the capillaries, as the arteries were obstructed by clots. Later on, I succeeded in filling the arteries with hot water. These anatomical experiments fixed the quantity of water necessary to fill the veins only, at 200 grams; the amount reached 250 grams when the arteries were also filled.

The increase in weight of the placenta to half of its normal weight (500 to 600 grams) and the subsequent overswelling of the villi would act strongly upon the uterus to bring about the detachment of the placenta. It was my belief that the injection of salt solution through the omphalic veins in the cord of the living would do no harm; consequently, I mentioned my idea to Professor Petsalis and Dr. Negrepontis who readily gave me permission to apply my method on lying-in women. Thus, assisted by Dr. Adrianakos, I tried the method in 30 cases in the University Lying-In Hospital. I wish to express my thanks to each of these colleagues.

I was present during the administration of this method in 7 of the 30 cases, and in these 7 cases the method was successful. For the most part the results in the remaining 23 cases, which Dr. Adrianakos attended, were also successful. When I say successful I mean that, by the application of this method immediately after the cutting of the cord, the placenta was expelled spontaneously within 3 to 5 minutes, and without any other manipulation. In a few instances the injection was not entirely successful and the Credé method had also to be used.

The failures were due to imperfections in technique: (1) the cannula was inadequate or too sharp, thus sometimes injuring the wall of the vein; (2) we divided the cord too far from the orifice of the vagina, thus the veins in part of the cord exposed to the air were filled with clots, and when the clots were pushed along by the solution injected, they obstructed the internal branches of the vein and rendered injection incomplete or provoked rupture of the vessels; (3) the central part of the omphalic cord was tied (as was the usual custom) and as it was filled with clots the injection was hindered. When these imperfections were avoided the injection was always successful.

APPLICATION OF THE METHOD

The necessary instruments are: (1) an ordinary syringe; (2) a metallic cannula attached to the distal end of the rubber tube

(this cannula must have a perimeter of 1.5 centimeters and a groove behind the lumen to prevent slipping of the cord when attached to the cannula); (3) a pair of scissors and a clamp. Except for the cannula, this represents the usual outlay of instruments used by the midwife. The instruments are sterilized and we add 15 or 20 grams of salt to 1,500 grams of sterilized hot water (temperature 50 to 60° C.). This done we place the syringe 2 yards high and wait for the expulsion of the child. After the birth of the child and the cord is tied, we cut the superfluous part of it, allowing it to remain 3 or 4 inches from the vulva, pressing it off to let the blood flow. In doing this we stand at the right side of the patient. We then hold the cord with the left hand and turn it up so that we can see the wide lumen of the vein. Now we take the clamp with the right hand and put the one branch in the lumen and the other on the surface of the omphalic cord. We then press the clamp, thus immobilizing the vein which would otherwise easily slip away inside the whartonian jelly. We then introduce the cannula in the immobilized lumen of the vein and instruct the assistant to tie about the groove in the cannula, thus tying at the same time both the omphalic vein and arteries. If the vein slips we must try again. When the knot is firm we inject the salt solution into the vein which swells and takes on a white instead of the previous blue color. After two or three minutes, we can see the swelling of both omphalic arteries which become blue in color from the blood pushed into them through the capillaries by the force of the injection. The swelling of the arteries proves that the injection has been successful. So soon as 200 grams of salt solution are injected, detachment of the placenta begins, and as detachment gradually progresses the water flows more quickly from the syringe while the thin blood mixed with water flows from the orifice of the vagina. To fill completely and to wash out the blood from the internal vessels of the placenta, we cut with scissors first the one and afterward the other omphalic arteries. If the injection has been correctly done, we see the blood springing out at a certain distance. When the blood has been washed out and water comes from the arteries we press them with a clamp and await the result of the injection.

To prevent the clots in the vessels and facilitate the circulation of the injected liquid I add lately 2 per cent sodium nitrate in the salt solution. The results obtained with this solution have been better than with simple salt solution.

CLINICAL SIGNS

We observe the following subjective phenomena. One to two minutes after the injection, the parturient has a burning sensation inside; two to five minutes later, she suffers pain due to the commencing uterine contraction. Objectively, the following phenomena are observed: Two or three minutes after the beginning of the pain a little blood flows from the orifice of the vagina, the fundus of the uterus comes higher up, and the cord slides 4 or 5 inches away from the orifice of the vagina. These phenomena show the detachment of the placenta, which lies now between the cervix and the vulva in the vagina, where it may remain for two to four minutes. A strong bearing-down strain is required or a light pressure over the fundus to complete the expulsion of the placenta which appears at the orifice, swelled with the distended vessels. Expulsion of the placenta is followed by expulsion of the membranes.

In the first cases the delivery of which I attended, as soon as the placenta was expulsed the midwife in attendance twisted it, together with the membranes. I asked that this procedure be omitted because the membranes are easily separated without it.

But the most important clinical signs after the expulsion of the placenta are: (1) the complete and regular contraction of the uterus which becomes nearly as hard as a stone, and (2) the stopping of the bleeding. These advantages were observed by my assistant, Dr. Adrianakos, and confirmed afterward by the first assistant, Dr. Negrepontis, in cases of inertia of the uterus.

I shall refer later on to the anatomical construction of the placenta in the cases in which my method may be applied.

EXPLANATION OF THE DETACHMENT

To explain the mechanism of the rapid separation of the placenta, by the procedure described, it is necessary to recall some anatomical considerations. The placenta consists of two parts which are connected. One part, the embryogenic, is thicker than the other and is the continuation of the omphalic cord; and the other, the metrogenic, thinner part is formed from the chorium of the mucous membrane of the uterus and is called decidua. These two portions communicate by processes; those of the embryogenic part are called villi and those of the maternal part, partition walls. But the union of the two parts is of loose texture and relative, because between the parts it remains a highly wrought space between the villi, in which on the one hand the metroplacental arteries pour their blood and on the other the metroplacental veins. By means of this space, the maternal blood circulates, and in it swim and are implanted the villi of the embryogenic portion.

The metrogenic portion is formed of two layers: The first is more compact and is united firmly with the villi which, demarcated in lobes, constitute the cotyledons. The second is a spongy substance made up of minute bundles and leaves by means of which it is united to the uterine muscular coat. In this spongy layer is brought about usually the separation of the placenta.

The embryogenic portion is a disc, about 2 centimeters thick, the surface of which is turned to the metrogenic portion and bears numerous free villi running in the space between the villi or implanted by their top in the metrogenic portion (decidua). This construction is similar to that of the umbilical cord which at its end toward the uterus is expanded and implanted in the uterine mucous membrane by numerous rootlets, the villi. The cord contains three vessels, two arteries, and one vein, which in the interior of the villi are united by a capillary network; consequently, if we pour liquid from one of the arteries it will pass through the capillaries of the villi to the umbilical vein; and inversely if we pour liquid in the vein it will pass through the capillaries to both arteries. If injection were tried in the vein of another organ, it could not be accomplished on account of the valves; but the umbilical vein is generally without valves.

Having mentioned their fundamental features, I will try to explain what occurs in applying this new method. The explanation is not complete as the result of the histological examinations is still wanting. However, I believe that many factors help to bring about the separation of the placenta. These are: The increase in the weight, the swelling of the villi, the infiltration and rupture of the capillaries of the villi, and lastly, the temperature of the injected solution. These factors act chiefly on that part of the muscular coat of the uterus which is connected with the placenta and which does not, like the other parts of the uterus, contract immediately after the expulsion of the fœtus. The weight increases considerably by the injection, increasing more than half the normal weight. The thin layer of the spongy substance is dilated and thus the fibers of the neighboring muscular coat of the uterus are stimulated and contract. The result is a bursting of the fibers in the spongy portion. We do not know whether the increase in weight alone is capable of separating the placenta, because we cannot exclude the action of the other factors during the experiment. To determine this point, I tried metallic mercury in some experiments on expulsed placenta, but I believe that this is not yet permissible in the living.

A second factor is the erection of the villi which results from their overfilling. The erection and the swelling of the villi cause some shaking of the cotelydons from their coat as if they were, so to speak, lifted by lever action, while at the same time the adherent villi are ruptured. Bearing in mind that some of the villi . go deeply into the decidua bringing with them the choriodecidual vessels, we can understand that the erection or the rupture of the villi assists also in the separation.

The third factor is the infiltration of the salt solution behind the placenta. This I have proved by adding methylene blue to the injected liquid. When the placenta was

expulsed it had large blue stains on its implanted surface. But the best demonstration is the experiment on the parturient. Here after the separation of the placenta has commenced (i.e., after the injection of 200 grams), the liquid falls abruptly in the syringe, while watery blood flows from the orifice of the vagina, which at first may cause the observer to fear that hæmorrhage is taking place. But this fear is soon dismissed by the state of the pulse. As a matter of fact the liquid is some blood mixed with the injected solution. If the pressure is increased this watery blood becomes more abundant and assists in the more rapid separation of the membranes.

The importance of infiltration of liquid behind the placenta is shown by nature herself. Nature uses the same process to accumulate blood behind the placenta; so-called retroplacental hæmatoma resulting from the rupture of vessels lying between the uterus and the placenta.

Further histological examination of the placenta will prove exactly where the infiltration or rupture of the capillaries occurs. I suppose that first it fills the space between the villi, canalized as it is known by the final venous sinus and uteroplacental veins. Were the muscular part of the uterus connected with the placenta not contracted, then the liquid could, of course, enter the uterine circulation and the stagnation in the intervillous space could not occur. But the immediate muscular contraction of the uterus compresses the veins as would a clamp and the injected liquid distends the final sinus and infiltrates the spongy layer, all this resulting in rupture of the cotyledons and the uteroplacental vessels.

Two other important questions have arisen in regard to infiltration; i.e., first, whether the passage of the liquid is due to the strength of the solution (hypertonic); and, second, how the passage of the solution through the villi to the decidua is effected. Tests were made by adding to the solution injected a colored, sterilized substance and later making histological examinations of specimens expulsed.

Last but not least we must consider the heat of the solution as a factor in bringing about the separation. The heat may act on the final nerves or directly on the muscular coat of the uterus and chiefly on the deeper villi (choriodecidual vessels). The action of the heat is reinforced by the salt which excites contraction in the muscular fibers. One might think that the same action could be obtained by a simple intra-uterine injection of hot water, in which case the injection of the omphalic vessels would be superfluous. To this objection I answer first, that the intra-uterine hot injection is not sufficient to accomplish results as the thickness of the placenta and the membranes prevents the action of the heat upon the muscular coat; second, that the intervillous injection as accomplished by my method acts directly upon the muscular coat by a sort of spray from numerous minute springs. Hence the effect is quick and constant and the contraction of the uterus strong. This is the explanation that I offer for the injection in the omphalic vein. The general application of it will show later on, which of the factors mentioned above is more important and whether or not other factors contribute also to the final result. If we compare my method with that of Credé I may perhaps say that my method is superior to the latter. The Credé method has a certain amount of danger connected with it, because it embodies rough manipulation of a very vital and delicate organ, the uterus, while my method is safe and gentle and gives tone rather than causes injury to the uterine muscular coat.

One might object that from the point of view of the practical accoucheur, the most important thing, is the detachment of the "placenta accreta." I had only one case in this category. The Credé method was applied without result and then instead of proceeding with the hand a hot intervillous injection was used and resulted in the detachment of the placenta only a little later than usual. One case cannot, of course, prove the point. However, I have two other cases in which forceps were used on account of uterine inertia. In both cases, after injection the placenta was expulsed within five or six minutes and the uterus was completely

contracted while bleeding was immediately stopped. I think that the question of the quick detachment of the normal placenta is definitely settled. The use of the method described will convince every one that its effectiveness consists, first, in the immediate and complete contraction of the uterus, and, second, in the suppression of any bleeding, which is important, as postpartum hæmorrhage has a bad effect upon the mother during childbed and nursing.

The question of the application of this method in the treatment of retained placenta remains unsettled, because the number of cases in which the method has been used is not yet sufficient to estimate results. But I think that even in such cases the method will be effective if, as Bumm believes, the retention of the placenta is not due to inflammation and firm adhesions, but to other still unknown causes. As the method has not as yet been used in such difficult cases, I publish this paper hoping that the method will be used by others and their findings recorded.

BIBLIOGRAPHICAL NOTE

While this paper was in process, my distinguished colleague, Dr. Andreou, drew my attention to the *Handbook of Therapeutics*[1] in which the separation of the placenta by the "cold injection of the omphalic vein of Mojon" is mentioned. I then searched the literature and found that a hundred years ago, the Italian professor of anatomy and physiology in Genoa, Benedetto Mojon, first described the detachment of the placenta by the injection in the umbilical cord, in a paper entitled *Sull' injezione dell' placenta*, Livorno, 1826. This paper is not in the possession of the Italian national library but I found a brief description of the Mojon method in the obstetrical work of S. Kanzoni[2] who obtained good results and recommends its use.

It is difficult to explain why this logical method was completely abandoned. I suppose the lack of asepsis and the use of cold water which would make the injection impossible because of clots in the capillaries and omphalic arteries rendered the application difficult and dangerous.

Although using the same route (omphalic) as that of Mojon, my method is different in many ways: (1) it conforms to the new methods of aseptic obstetrics; (2) it produces a complete filling of the vascular system of the placenta and therefore a swelling of the villi; (3) the injected hot water increases the natural hæmatoma behind the placenta; and (4) the injection is made with hot hypertonic salt solution to which I have lately added 2 per cent citrate completely to dissolve the clot.

Up to the present time more than 60 cases have been successfully treated in the University Lying-In Hospital, of Athens. I believe that the method is especially suited to the man who practices under great difficulties in the little town and village, and who would hesitate to introduce his hand into the vagina when he is able to obtain the same result with a simple and safe method.

[1] Traite pratique des accouchements, ii. 487.

[2] 4th ed., 298.

STERILITY[1]

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DORLAND (4) defines sterility as inability to produce young, or barrenness, while Polak (29) defines it as the inability of a woman to produce a living child. It is difficult to agree with the latter definition for surely a definite pregnancy precludes the application of the word sterile to a woman.

It has been questioned whether sterility is a disease or a symptom; it depends upon the case. If there are many gross lesions in the pelvis and sterility is present, the latter is a symptom; if, however, a woman is sterile and the pelvis and her constitution generally are found to be normal, then sterility is a disease, and it is a disease which causes many symptoms, neurasthenia being the most prominent.

Female sterility concerns us chiefly here, but it is impossible to consider this subject without bearing in mind that the male may be at fault. If a woman who is sterile has some definite lesion which may be a possible cause of her sterility, that lesion must be corrected. If no lesion is apparent it is necessary to examine the semen. A sufficient and satisfactory examination is made by means of a condom. Huehner (15) does not consider this sufficient as he says not only must the number and vitality of the spermatozoa be considered, but also the power of the penis to ejaculate the semen so that it reaches the cervical os; in fact, Huehner says that the only test that the male is normal is that live spermatozoa reach the cervical os. It is simple to ascertain the power of the male by questioning him. While the so-called effluvium seminalis is present in some cases of sterility it is not invariably so, and as it is sometimes found in fruitful women it is not a sign of much moment.

For all practical purposes a marriage may be considered sterile when pregnancy does not occur after 18 months.

Various classifications have been attempted by different authors and it is unnecessary to mention them all here. A classification which embraces all varieties is, first, due to the man; second, to the woman: and to subdivide these into absolute, when some organ necessary for conception is absent; relative, when there is no such absence but either the man or the woman is sterile. There is an old wives' tale that twins cannot have children, or if they have children, the sex must be the same. Both these ideas are untrue, and if one of a pair of twins is sterile there is some pathological condition present.

In dealing with the subject of sterility rules must be laid down to be followed in a given case.

When the patient seeks advice, her history, general and gynecological, is taken. Questions are asked as to the performance of the sex act; if the answers are unsatisfactory, instruction is given. Enlargement of the thyroid gland, when presented, is noted. The breasts are examined and maldevelopment sought for. The abdomen is thoroughly investigated. Excessive obesity is especially of moment. The latter is frequently found and is said by Opitz (26) to be due to some fault in thyroid secretion. Weil (38) also agrees that sterility is in certain cases due to disturbance of the hormone action of the thyroid, while McKee (21) says that sterility is due to fat causing maldevelopment of the ovaries. Whatever cause it is due to, fat patients who are sterile, often become pregnant after being placed on a suitable diet and being given glandular extract. Horrocks (14) gave the capon as an illustration of sterility in conjunction with obesity. The vulva is next inspected for any signs of inflammation, painful urethral caruncle, intact or inflamed hymen, maculæ, gonorrhœa, tumors or other abnormality. If present they are treated by the recognized methods. Having examined the vulva, the vagina is explored digitally and with the speculum. Stenosis of the vagina with its resulting vaginismus and dyspareunia is a most common cause of sterility. This condi-

[1] Abridgment of presidential address given at opening meeting of the Dublin Biological Association, October 5, 1919.

tion is sometimes hysterical and can be overcome by suggestion together with advice to the husband. Vaginismus may also be caused by vulvar tenderness; a little cocaine ointment applied before coition often acts as a cure. When definite stenosis of the vagina is present, it is found in most cases near the vulvar orifice and is due to rigidity of the large pelvic muscles of support as chiefly represented by the levator ani muscles. The treatment in these cases is as follows: the first two fingers of each hand are placed in the vagina and the latter is stretched until a tearing of the fibers is felt: a Sims glass speculum of a size which will fit exactly into the vagina is next inserted. A larger size is introduced every second day for a week. A recent treatment suggested for stenosis of the vagina consists of an operation which is called "enlarging of a tight perineum" (Graves, 8). Any uterine or adnexal abnormality is corrected. Vaginal cysts are sometimes found. These are usually congenital in origin. They may cause sterility by acting as a mechanical impediment in coition or by acting as a barrier to the entrance of spermatozoa into the cervix. Other tumors of the vagina may be present. Although I have met with several cases of cyst in association with sterility I have never met with any other vaginal tumor in these cases. When present cysts are removed.

Before withdrawing the speculum, the reactions of the vaginal and cervical secretions are examined. In this connection Huehner (15) whom I have already quoted seems to have found a vast number of cases where the cervical secretion was changed. The vaginal secretion, as is well known, is acid; the cervical secretion is alkaline. Spermatozoa can live in the vagina according to different authorities for a period of from 3 to 12 hours. This might lead the unwary to prescribe alkaline douches in all cases of sterility. While this might be successful in a few cases, the douching if persisted in might easily cause a vaginitis which would lead to dyspareunia with resulting sterility from that cause.

Huehner (15), Polak (29), and many others have drawn considerable attention to the quality of the cervical secretion, and sterility is attributed to acidity in a great number of cases. Reynolds (32) has noticed that the cervical secretion is sometimes sticky and may entangle the tail of the spermatozoon. It has not been my experience to find an absence of alkaline secretion in more than half a dozen cases, and in these there were other conditions present which were corrected by operation. In patients who have a cervical secretion which is not markedly alkaline, a douche of phosphate of soda, one drachm to the pint, is ordered just before coition.

Spermatozoa, as stated above, die in the vagina in about 3 hours; they live in the cervix for 6 to 8 days. This is an important point to bear in mind, not only from the view of treatment of sterility but from the standpoint of legitimacy. The law has ordained that a child born 304 days from coitus is legitimate; it is to be supposed that the learned judge took into account the period which the spermatozoa spent in the uterus or the tube before fertilization occurred. Even then there were good grounds for doubt.

While the speculum is still in the vagina, the cervix is carefully examined. Erosion, conical cervix, and pinhole os are sought for. If a pinhole os or stenosis of the cervix is present, the treatment consists in dilatation by means of Kelly's modification of Hegar's dilators, then in insertion of seatangle tents or stem pessaries. The latter instrument which was invented by Miller in 1903, although recommended by many learned gynecologists such as Norris (25), is to be heartily condemned. In a discussion in 1917 on their use, Kolischer (16) was the only one against them. The idea of leaving in the uterus for some time a foreign body which might very possibly cause salpingitis is contrary to the principles which I hold, that a septic condition of the fallopian tubes is the most common cause of sterility. For the same reason tents which take time and care to sterilize properly and which must remain in the uterus for a considerable period are not recommended. In using the metal dilators, experience teaches the size necessary to secure sufficient dilatation. A No. 10 dilator of the ordinary Kelly-Hegar type is ample. Mundé (24) and other writers have urged that the dilated cervix closes after dilatation and that the cure of sterility is effected not by

the mechanical effect but by some unknown action on the nerves of the uterus. Probably both aid. It is not necessary to place a glass dilator in the cervix as suggested lately. If a piece of 1½ gauze is placed in the canal for 24 hours, after the dilatation, an examination 3 months later will reveal no stenosis. Care must be taken not to tear the cervix in dilating, or an endocervicitis or possibly a pelvic cellulitis will result. So long ago as 1874, Beck (1) stated that the aspiratory action of the uterus was proved; also that in coition the os opened, had a rhythmical action and became soft; and that there was a tilting of the uterus toward the vagina. This belief has been shared by other investigators. If an erosion is present it should be removed, for the discharge which arises from the outer surface is inimical to the spermatozoa. There is no good object attained by palliative treatment. This last observation is made with the excellent monograph by Leonard (18) before me. Leonard in his conclusions gives the reason why partial amputation of the cervix fails. He says: "Four-fifths of the women remain sterile after the operation; yet *in certain selected cases of persistent sterility*[1], amputation of the cervix seems to be the only practicable procedure. This postoperative sterility is probably mechanical in origin and may be due rather to narrowing of the external os through encroachment by the edges of the vaginal mucosa or to a stenosis of the cervical canal. Pavlik (28) bears testimony to all the bad things Leonard states about the operation. My experience is very different and I have had many cases to prove this. Goldberger (8) agrees that conception is just as frequent after a properly performed amputation as before. *In other words, the operation must be properly performed.* Palliative treatment does not and cannot cure an erosion; a carefully performed Schroeder's amputation will do so. An hypertrophied cervix is often found in cases of sterility. It causes sterility mechanically by lengthening the cervix and where there is great length by causing dyspareunia. A circular amputation of the cervix should always be done in these cases. Before leaving the cervix, two well known operations must be mentioned, namely: Pozzi's and Dudley's. The former which was described in 1909 was practised by me soon after its description was published. It consists in the bilateral division of the cervix and the keeping open of the cervical canal by means of sutures. Pozzi (30) uses silver wire. It did not appeal to me and I discontinued it. The old operation of simple splitting of the posterior lip of the cervix need not be considered. The modification of Dudley's posterior division is extremely useful in some cases, for example in the case of a retroverted, anteflexed uterus in which the os uteri is pointing forward and in which the resulting operation brings the os pointing to the receptaculum seminalis. This operation has one great disadvantage: it is easy to perform and from results I have seen, the easiest to perform badly. Many times have I observed the leucorrhœa discharge pouring from the unhealed edges of the posterior division wound, a condition in sterility most difficult to cure. If this operation is done in selected cases with great skill, it will be found of benefit. Blair Bell (2) has done the same operation on the anterior lip, but it appears to be an irrational procedure.

Tumors of the cervix are occasionally a cause of sterility, the most common being the pedunculated submucous myoma. This, when present, must be removed. Malignant disease of the cervix is practically never seen. In fact, it has been demonstrated that parity and cancer of the cervix go hand in hand (Since writing this I have had to perform a Wertheim operation for cancer of the cervix in a sterile woman of 31).

Having considered the cervix, the body of the uterus must be brought forward as the next offender. It may act as a casual factor in many ways: first, endometritis may be present. In making use of the word endometritis, dangerous ground is being invaded, for at the present time it is a moot point what endometritis really is. I look upon it as a condition which shows itself by symptoms; in other words, a woman may be considered to have endometritis who has heavy and frequent hæmorrhages which condition is relieved by curettage of the uterus, the curettings being later examined by a competent microscopist and diagnosed as such. It is dif-

[1]My italics.

ficult to agree with Hitschmann and Adler (13) and their followers who believe only in chronic interstitial endometritis and who say that glandular endometritis does not exist. The most logical classification of chronic endometritis seems to me to be: (1) chronic interstitial, i.e., of infective origin; (2) chronic glandular, being subdivided into hypertrophic and hyperplastic, of congestive origin. Take whatever division is most pleasing, the fact remains that the relief of the symptoms by curettage of the uterus carefully performed is a most useful adjunct in the treatment of sterility. In speaking thus of curettage it is necessary to utter a word of warning. It is a common belief among laywomen that curettage will cure all cases of sterility. This, of course, is a fallacious belief and leads to a wholesale abuse of the operation of curettage and brings discredit on the profession. A curettage, if done at all, must be done most carefully and aseptically, and to take as a general rule that it should be performed for all sterile women will be fatal to the chance of curing them. Too often have patients consulted me who have been made absolutely sterile by a badly done curettage. If any gynecological operation is being performed for the cure of the sterile woman, and she suffers from endometritis, curettage should be done. If she has no such symptoms curettage is incorrect treatment and lessens any chance of pregnancy which may be present. Dilatation of the cervix is done in all cases requiring operation.

Tumors of the uterus may cause sterility and a myoma is found as a common causal factor. Young (39) in an investigation on this subject, determined that the percentage sterility rate of women with fibroids was 31 against 10 in ordinary women. The cause of myoma is not known, but the well-established fact that this tumor is usually found in sterile women leads me to agree with those who consider that the tumor, in some cases, takes the place of the fœtus; that it is the unused energy of the uterus. The one form of treatment for the sterile woman is myomectomy. As will be seen later many cases have been cured. These were not cases of single tumor. In some of them a part of the uterus in addition to the tumor was removed. It is sometimes difficult to prognosticate about fibroids before operation, for sometines a woman who is anxious for children has a fibroid uterus which it is impossible to leave *in situ* and the patient should be warned and permission should be obtained that hysterectomy is to be practised if necessary. Some writers have spoken of the dangers of the rupture of the scar in subsequent pregnancies. There is no danger of this accident. The best technique for myomectomy is to introduce one or two tension sutures of silk in addition to the ordinary catgut. It is seldom that the pedunculated myoma causes sterility. It is far more common to find the interstitial or submucous type. Sterility is a definite contra-indication to the use of X-rays as a treatment for myoma.

Displacements of the uterus rank with tubal inflammation as a most common cause. Backward displacement with or without adhesions and other complications is most frequently encountered. Women may become pregnant who have backward displacement; but when sterility is present and there is a retroversion the latter may be certainly looked upon as the cause of the former. I was consulted recently by a girl about to marry. She wished examination under anæsthesia to determine her chances of conceiving. Everything was normal except for a backward displacement. The views outlined above were explained, she asked for operation and she was wise. In dealing with a sterile woman who has a mobile backward displacement there are two treatments to consider: the pessary treatment and the operative. Although strongly in favor of the latter, the former is useful in certain cases. Pessary treatment, if practised at all, should not be persisted in for more than three months; there is an ever present danger of sepsis spreading upward to the fallopian tubes, and it is much better on account of this danger to operate immediately. I do not intend to delve deeply into a discussion as to the most suitable operation. Alexander Adams' operation should be studiously avoided although Hayd (11) recommends it, even for sterile women. The abdomen must be opened so that the state of the tubes, ovaries, and other pelvic contents may be examined. Generally I

practise a modified Gilliam operation in which, after the abdomen is opened by a mesial incision, a curved forceps is guided underneath the aponeurosis of the rectus muscle to the internal abdominal ring and thence to a stitch which has already been placed on the round ligament, 1 to 1.5 inches from its uterine end. The ligament is then drawn through and sewed with No. 3 silk, to the under surface of the rectal aponeurosis at its outer margin. Thus the uterus is secured extraperitoneally and there is no danger of intestinal obstruction. The results, both symptomatic and in pregnancy and labor, are excellent. If the ligaments are not strong, ventral suspension is done. The Gilliam modification is preferred on account of the weight of feeling in the profession against ventral suspension. I have attended many women in confinement after ventral suspension without any untoward result. The prognosis in this type of case is extremely good.

While mobile displacement is found in connection with sterility, it is far more common to find a uterus fixed by adhesions and associated with tubal disease. When this is the case, palliative treatment is strictly taboo, and it is difficult to believe that sterile women with retroverted uteri fixed by adhesions are still being treated by such temporizing measures as tampons of ichthyol in glycerine, rectal massage, etc. There is no possible excuse for such treatment. While palliative measures may loosen adhesions to an extent sufficient to replace the uterus, they cannot open tubes; therefore, the only treatment is operation. As this operative manœuver entails a consideration of the fallopian tubes, the ovaries, and broad ligaments generally, it is well to consider these organs at this point in the paper.

Abnormalities of the fallopian tubes may be regarded as the chief cause of sterility, a view which is shared by Goullioud (9) and many others. Tumors and displacements of the tube need not be considered. Salpingitis may be taken as the only pathological condition to be reckoned with. This salpingitis may occur in many ways. Sometimes it may assume the dimensions of a large tubercular pyosalpinx. Brown Miller (22) states that such a condition produces a sterility which is often incurable. It may assume various degrees from a normal sized tube with closed ostia to a large hydrosalpinx or a tube with nodular inflammatory areas. Kinks are not limited to the intestine and Arbuthnot Lane. Gynecologists may have kinks and these are present in the tube. Some investigators among them, Tweedy (37), have suggested an excessively long tube as a possible cause of sterility and Opitz (26) refers to excessive length as predisposing to tubal pregnancy. I am not prepared, on finding a lengthy tube, to resect it.

It is sometimes difficult to conjecture the origin of the salpingitis which causes sterility. Gonorrhœa is probably first as an etiological factor, and it is of interest to note that Schaeffer (34) reports that in 451 cases of sterility gonorrhœa was traced in 67.3 per cent. Faulty technique may be reckoned as a good second factor, and under this heading may be mentioned the palliative treatments already condemned. It has, however, often been found on opening the abdomen that tubal diseases existed to a marked degree where curettage had been performed. I believe that septic instruments may be deemed to be prime offenders. It is astonishing to say that in my practice recently I met an unfortunate woman who had submitted three times to the operation of dilatation and curettage for the cure of sterility and who had marked salpingitis and abdominal adhesions! Tuberculosis of the tube is of very frequent occurrence.

The technique of operative treatment of retroversion of the uterus complicated by adhesions or adnexal trouble is as follows:

When the abdomen is opened the uterus is drawn up by a uterine forceps, or by a stitch. All adhesions are separated from below up. Those that can be done digitally are manipulated in this manner; in others where the intestines are adherent the adhesions are separated with a curved blunt pointed pair of scissors, taking care to avoid the gut wall. Raw surfaces are oversewn. The tubes are next examined and a decision come to as to the necessary measures to ensure at least one working tube and ovary on the same side. The tube is gently drawn upward and is held in a wipe: no heavy forceps are placed on it. If

there is nothing wrong, the tube is blown up by means of a sterilized ear syringe as a routine. If the ostium is closed it is opened. A smooth director is passed along to explore its patency. It is then blown up with the syringe, which process exposes all kinks. These are cut and the raw surfaces are oversewn at right angles to the tube with fine catgut. As recommended by Tweedy, catgut is next placed in the lumen. I use No. 4 catgut in the thickness of 8 strands when the ostium only is at fault. Tweedy and I reported one case each of tubal pregnancy following this routine, but since that I have had several cases of intra-uterine pregnancy. As, however, pregnancy has followed resection of the tubes without insertion of catgut, this is evidently not a *sine qua non* but it certainly is an improvement. When there is a constriction or a nodule in the isthmus, one is confronted with a difficulty. Is it better to remove the diseased portion and perform an end-to-end anastomosis or should the fimbriated extremity be removed as far as the diseased area? Young (40) has reported pregnancy following amputation of the outer halves of both fallopian tubes. Some writers have urged that the fimbriated extremity is necessary to successful conception. While agreeing to a certain extent, I am not in complete accord, for there have been several cases in my experience in which impregnation occurred after both fimbriæ had been removed. The question really lies between, first, removal of the fimbria, the new ostium being resected and catgut being placed in the lumen and passed by means of a long straight needle eye foremost into the uterus or, second, removal of the diseased portion, end-to-end anastomosis of the two ends and catgut being inserted at the resection, or the mesentery if the resected portion is first ligated. A long director is next threaded with catgut and brought to the cut surface. The catgut is next threaded on to a straight needle and is brought to the uterus as already described; it is necessary to change from the director to the needle owing to the diminished diameter of the uterine end of the tube. The end-to-end anastomosis is next concluded. After trying both of these methods the former is my choice, although in certain cases the latter method is preferable. I believe if the catgut is placed at the raw surface, it is not important whether it goes into the uterus or not. In my search through the literature I was amazed to find many ingenious methods which had been devised for catheterizing the tubes. Tyler Smith (35) in 1849 in a paper illustrated by figures, shows how he successfully catheterized the tubes by means of a hollow silver tube suitably curved at the distal end, the point of a whalebone instrument being then conveyed to the cornu. Madden (20) practised the same technique. Bullard (3) in an admirable paper of recent date shows some striking statistics following resection of the tubes. Gersung (6) has reported a case of removal of one tube and hydrosalpinx of the other which was cured and followed by pregnancy. Montana (23) has a pregnancy following double salpingostomy. Palmer Dudley (27) has 43 cases of pregnancy following plastic operations on the tubes, but he says he has only 2 from definite repairs. My statistics make me more hopeful about results. I do not intend, and I do not believe it enters within the scope of this paper, to discuss the peristaltic or cilia action of the tube and how conception occurs. I trust I may not be considered unscientific, old fashioned or pessimistic about the future when I say that I do not believe that the mysteries of birth and death are for us. Sometimes when the abdomen has been opened it is found that the uterus and adnexa are so diseased that nothing can be done.

When the examination and treatment of the tubes are concluded, the ovaries and broad ligament are examined and pathological abnormalities corrected. Ovaritis combined with salpingitis is often seen and is dealt with. It is seldom necessary to open the abdomen for ovarian trouble alone, though large one-sided papillomatous or adenomatous tumors are sometimes found in the sterile woman. It is, however, extremely common, having opened the abdomen for some other trouble to discover small cysts. In fact this condition is so commonly found that it may be looked upon as one of the signs of sterility, a fact with which Reynolds (32) agrees. If these cysts are present, the best treatment is removal. I am very slow to do complete

oophorectomy except in the case in which the tube of that side is beyond all repair. It has been stated by Kosmak (17) and Fallenberg (5) that removal of one ovary gives better function to the other. While this applies to the wholly diseased ovary, it does not apply to the women with ovaries containing cysts. It is certainly important to remove these small cysts. Whether they are associated with toughness of the ovarian stroma as suggested by Hedley (12) and in that respect allow the ovary to function better it is difficult to say, but good results follow resection. The small cysts which are often found in the broad ligament are removed. If displacement is present, a modified Gilliam operation is performed.

When the examination is completed, if nothing abnormal has been found in the pelvis, the general condition of the patient must be studied. Endocrinology is still in the experimental stage, and it is to be hoped that the reciprocal action of the thyroid and of the other ductless glands, with the genital organs will be thrashed out at an early date. The administration of glandular extracts when continued for a lengthy period and given in suitable cases meets with remarkably successful results. The most successful cases are those in which there is very little menstruation. Ovarian extract and dried corpus luteum (P. D.&Co.), especially the latter, give the best results. Fallenberg (5), in common with many others, has noted its good effects. A start is made with 5 grains daily and this is gradually increased until by the end of the month 30 grains are being taken in the day. The extract must be taken continually through the period and the treatment should be persisted in for one year. Often pregnancy results after 6 months. Even if the desired pregnancy does not occur, no harm is done, the general condition of the patient is improved, the menstruation is better in color and quality, and the uterus is slightly enlarged. To some the extract varium (B. W. & Co.) is given instead; at various times other glandular extracts and some mixed glandular preparations such as ovomammoid and hormotone are given. There is no doubt that ovarian extract is the best. The cost of these drugs is a grave disadvantage in the treatment of dispensary cases.

If the menstrual function is normal, if the pelvic organs are apparently normal, and if the man is normal, what can be advised? There is then only one rational procedure: dilatation of the cervical canal followed by laparotomy. At the laparotomy, if there is nothing abnormal, the tubes should be dilated. If there are such conditions as hydrosalpinx, broad ligament cysts, or other conditions mentioned already, they must be corrected.

The point I wish to emphasize most clearly is that if the patient is anæsthetized, the abdomen should in nearly all cases be opened. It does no harm. It means that everything possible has been done. I have dwelt already on the fact that closed ostia and other well-nigh undiagnosable conditions may be present. I quite appreciate that many women have become pregnant after a simple dilatation of the cervix, but the greater percentage who become pregnant when the abdomen is opened is an ample justification for laparotomy.

Appendicitis is a frequent association of sterility, but it is probably a precursor to salpingitis or it sets up adhesions and draws back the uterus. If the inflammation is found in the course of an operation for sterility, the offending organ is removed.

No definite mention has been made of venereal disease in this paper. I do not believe that venereal disease is nearly so commonly found as is believed. It is a pity indeed that syphilitides are not sterile, but it is a truism that syphilis shares with tuberculosis an unwanted fertility.

If a cure for sterility cannot be accomplished by any other means, direct insemination should be tried. It is a step which must and should be left until the last. The procedure adopted is as follows: Having been satisfied that there is nothing pathological in the pelvis of the woman and that the semen of the man is normal, the semen is collected in a condom and is injected into the uterus as soon after coition as possible. The patient is placed in the crossbed position; a vaginal douche of hot water containing sodium phosphate, one drachm to the pint is given, a Neugebauer's speculum is passed. The Braun's syringe

containing the semen is passed high up into the uterus and the fluid is injected. A tampon soaked in the remainder of the semen is then left pressed against the external os. There are not many cases in the literature; Rohleder (33) among others has reported some successful cases, and Lespinasse (19) speaks of insemination as a substitute for plastic operation on the cervix. I have not had a large experience of this treatment; in 17 cases there have been 6 successes. The time of election is from 3 to 5 days after the period.

Before coming to the concluding part of this paper which consists of my results, I would like to say that (1) one child sterility should be diagnosed and treated in the manner already mentioned for sterility; (2) contraceptives seem to cause sterility, a history of their use being given in many cases; (3) if all operations undertaken for the cure of sterility do not achieve their main object, at any rate they cure the abnormality for the correction of which the operation was undertaken.

With regard to my patients, in all cases the cervix was dilated except where this had been done previously. There were small cysts in the broad ligament in about half the cases. Kinks of the tube were present in many of the cases. These two conditions were so common that they were not always noted. The appendix was removed when it was pathological and where there were adhesions. In the cases of tubal resection catgut was inserted in the lumen.

Direct insemination cases and patients who became pregnant by treatment such as gland therapy without operation are not included in the list. As a routine after operation, ovarian extract is given to patients who have been suffering from scanty menstruation previous to operation.

The routine treatment of all patients was as has already been outlined in this paper. To the hospital patients who did not report themselves in person a letter containing the following questions was addressed and a stamped addressed envelope was enclosed.

1. How have you been since the operation?
2. Have you become pregnant?
3. If so was the confinement normal?
4. Give any further details.

The number of replies exceeded all expectations and this is to be attributed to the satisfaction experienced by those who had become pregnant and the desire for "something more to be done" by those who had not.

I have not included in this list cases which at the time of operation were found to have conditions which necessitated hysterectomy, or such other destructive operations which precluded any chance of pregnancy. The results in private practice are better than in hospital practice, for the reason probably that examination of the male is easier to obtain. The following typical case is sufficient. A woman seeks advice. Examination reveals the pelvis to be apparently normal. The woman is given this information; she asks if something cannot be done. In private practice the male is examined; in hospital, in this country it is impossible. Dilatation of the cervix and the fallopian tubes is performed in the case of the hospital patient. In the case of the private patient it is done after examination of the man. I have several times encountered cases where the husband had a chronic gleet—cases in which the woman was most anxious to be operated upon. These cases bring discredit on surgery in general and gynecological surgery in particular.

The following are my figures:

Letters written to hospital patients	302
Returned	13
Replied	281
No reply	8
To consider from above	281
Other patients communicated with by letter or otherwise	155
Total	436
Of these, became pregnant	205
Did not become pregnant	231
Percentage who became pregnant	47

The undermentioned was done for the patients who became pregnant: The same technique was carried out for those who did not become pregnant. The operation relieved the other symptoms of which they complained. Possibly in the case of some of those who did not become pregnant, the male was at fault.

Myomectomy (multiple)	9
Gilliam operation with dilatation of tubes with air—some complicated adhesions	59
Gilliam operation with resection of one ovary	30
Gilliam operation with removal of two ovaries	11
Gilliam operation with removal of one ovary	11
Resections of ovaries and dilatations of tubes	11
Ventral suspension with dilatation of tubes	7
Ventral suspension with resection of one ovary	2
Ventral suspension with resection of two ovaries	2
Ventral suspension with removal of one ovary	17
Gilliam operation and removal of one tube	12
Gilliam operation and resection of two tubes	4
Gilliam operation and resection of one tube	6
Dilatation and curettage of the former alone	9
Dilatation and Schroeder's partial operation	7
Circular amputation	5
Posterior division of the cervix	3
Total	205

Regarding bibliography, it will be noticed that the number of names is not large. In the literature the references are numerous. For a bibliography until the year 1913, I may refer the enquirer to the works of Huehner and Giles (7, 15).

CONCLUSIONS

The following are some of the conclusions arrived at from a consideration of the subject:

1. Sterility is a condition which at the present crisis of the population demands the serious attention of the profession. It is incumbent on the proper authorities to endow hospitals to a sufficient extent to allow thorough investigation to be carried out. Many women are denied admission to hospital through this lack of funds.

2. Sterility is curable in a large number of cases if care is taken to select the appropriate treatment. When operation is necessary, every minor point must be attended to.

3. When operation is determined on, the abdomen should be opened in nearly all cases.

4. The most common major abnormalities are backward displacement of the uterus and tubal inflammation.

5. The most common minor abnormalities are kinks of the tube, small cysts of the ovaries and broad ligament.

6. Dilatation of the cervix should be done in all cases requiring operation. Metal dilators should be used. Tents and pessaries which must remain in the uterus for some time should be avoided.

7. Even if sterility is not cured by operation the pathological conditions present are corrected.

8. There is no mortality.

9. The male should be examined when necessary.

10. Acid cervical secretion alone is not a common sign of sterility.

11. The administration of glandular extracts especially ovarian extract is useful in selected cases.

12. Finally, the statement must be reiterated that sometimes there is a definite physiological factor in conception, at present unexplained, which prevents conception.

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SAFETY FACTORS IN SURGERY WITH ESPECIAL REFERENCE TO THE BLOOD[1]

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MR. J. H. J., Case 19430, came under our care February 18, 1919, for an enlarged prostate with vesical calculus. The patient was semiconscious and unable to give his history. He was hiccoughing constantly. Physical examination showed the head, lungs, and heart negative; odor uræmic; the prostate enlarged. A searcher showed a stone in the bladder. The urine was ammoniacal; residual urine, 2 ounces; bladder capacity, 4 ounces. From his relatives was obtained the usual history of a gradually increasing prostatic disability. The systolic blood pressure was 180; diastolic, 135; pulse pressure, 45. Blood count: hæmoglobin, 90 per cent; erythrocytes, 4,640,000; leucocytes, 4,200; polynuclears, 71 per cent; lymphocytes, 28 per cent; eosinophiles, 1 per cent. Urinalysis showed albumin, triple phosphates, hyaline and granular casts, and rod-shaped motile organisms. The pulse varied from 100 to 130; temperature 98 to 99.2°F. Functional tests showed the following:

February 19, 1919. Phenolsulphonephthalein, first specimen (one hour), none; second specimen (two and one-half hours), 2 per cent; making a total of 2 per cent in two and one-half hours. Blood urea nitrogen, 136 milligrams per 100 cubic centimeters of blood; creatinin, 2 milligrams per 100 cubic centimeters of blood; blood urea, 291.04 milligrams per 100 cubic centimeters of blood.

February 25, 1919. Blood urea nitrogen, 88 milligrams per 100 cubic centimeters of blood; blood urea nitrogen, 188.32 milligrams per 100 cubic centimeters of blood; creatinin, 1.7 milligrams per 100 cubic centimeters of blood.

February 26, 1919. Under local anæsthesia (novocaine), a suprapubic cystostomy was done and a calculus removed. A Pezzer catheter was introduced. Bladder lavage was carried out.

March 3, 1919. Blood urea nitrogen, 57.7 milligrams per 100 cubic centimeters of blood; blood urea nitrogen, 123.478 milligrams per 100 cubic centimeters of blood; creatinin, 1.25 milligrams per 100 cubic centimeters of blood.

March 11, 1919. Blood urea nitrogen, 30 milligrams per 100 cubic centimeters of blood; blood urea, 64.2 milligrams per 100 cubic centimeters of blood; creatinin, 0.88 milligrams per 100 cubic centimeters of blood.

March 17, 1919. Blood urea nitrogen, 20 milligrams per 100 cubic centimeters of blood; blood urea, 42.8 milligrams per 100 cubic centimeters of blood; creatinin, 0.75 milligrams per 100 cubic centimeters of blood. Phenolsulphonephthalein showed a trace the first hour; second hour, 9.5 per cent.

March 24, 1919. A suprapubic prostatectomy was done under gas-oxygen anæsthesia. A Freyer tube was inserted and removed March 26. Irrigations were made daily. On March 29, the patient was up in a chair, he was eating well, his mind was clear, and the wound was rapidly closing. The pulse and temperature were normal. Recovery.

There must be some explanation for the fact that when two patients with similar conditions, as far as the usual examination is concerned, are operated upon by two surgeons of equal skill, or perhaps the same surgeon, one should recover and the other die There must also be some explanation for the fact that the man who is operated upon for appendicitis, on the kitchen table of his home, by his family physician, who has never before done an appendectomy, should make an uneventful recovery, while his neighbor dies after the same character of operation done by a noted surgeon in one of the city hospitals. Most certainly it was not the skill of one that saved his patient's life, nor was it the lack of skill of the other that was responsible for his patient's death; most assuredly one patient had a normal power of resistance through a normal metabolism and survived in spite of the operation, and the other with lowered resistance, the result of a disturbance of metabolism (which could probably have been foretold and the operation delayed), died in spite of the operation.

Since the discovery of Listerism, surgery has been busy perfecting a technique which has become so faultless as almost to preclude operative infection as a cause of death. Rubber gloves, aseptic ligatures, well trained operating room nurses and modern hospital accommodations have bred a school of "operators" which the laity and many of the profession fail to differentiate from, and daily confuse with surgeons. Until recently surgeons have been commendably occupied in unraveling pathologic problems as applied to the living and, as a necessary incident thereto, widening most extensively the domain of surgical therapeusis and, incidentally,

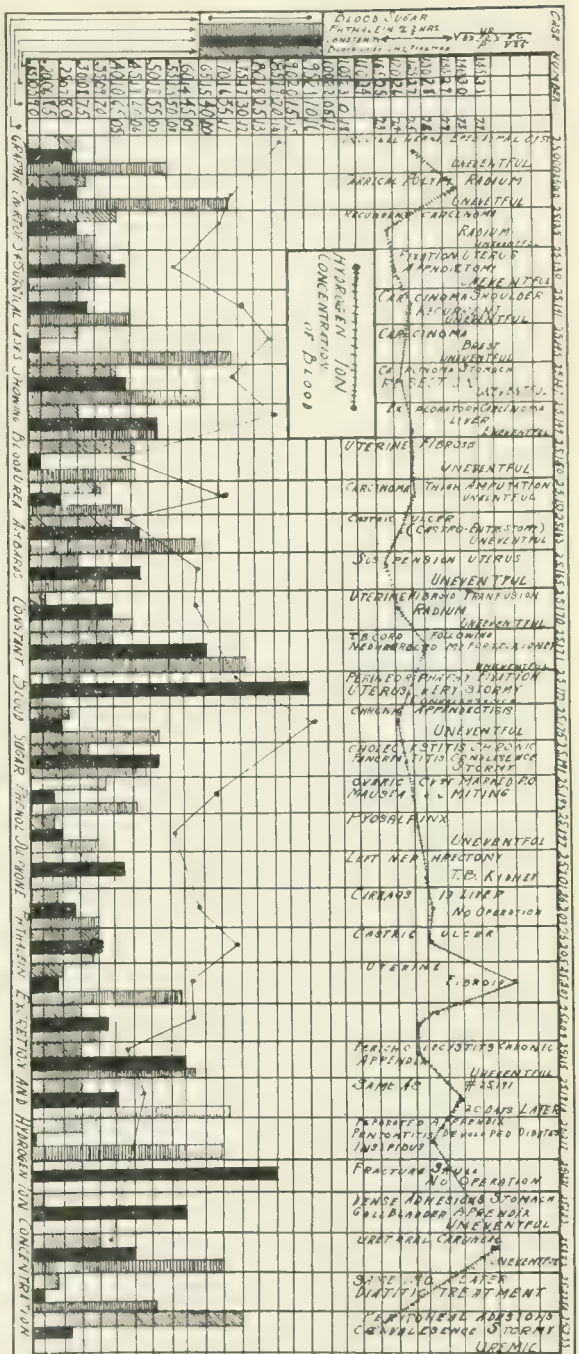
[1] Read before the American Association of Obstetricians and Gynecologists, Cincinnati, Ohio, September 15, 1919.

the opportunities for exploitation of the "operator."

We believe, however, that we are in the beginning of an era which will be marked by more careful and extensive study of the patient, not from the standpoint of making out a surgical lesion, but from the standpoint of his functional capacity to determine his exact resistance and thus ascertain a scientific evaluation of the operability of the individual. This will be an epoch of physiological surgery. The work of Crile, Henderson and others on shock, whether they are right or wrong; the work of Fischer and others, has opened a tremendously wide field for interesting and useful work. Stimulating the work of these men was and is the desire to reduce mortality, and as a consequence there has developed a wider and more extensive endeavor to estimate from the physiologic side the factors which play a part in producing death. In these endeavors we see the true surgeon, the internist, the physiologist, and the pathologist still working hand in hand.

The studies of Henderson and Fischer on acidosis, the investigations of Ambard and others on renal function, have enabled us to understand many factors we had not previously reckoned with, which play for or against recovery.

Despite the sphygmomanometer and sphygmograph, notwithstanding the "knocking at the door by opportunity" so clearly indicated in the work of Geraghty and Rowntree, until within the very last few years our preliminary estimate of operability has been most perfunctory and even more valueless. The examination consisted of an auscultory pulmonary and cardiac examination, a routine red and white blood count, and a urine analysis which concerned itself merely with the presence or absence of sugar and albumin and renal derivatives. These were done casually by an interne or mayhap an undergraduate nurse. How farcical, but oh! what importance we attached to them. Deaths we had, but then they were all from shock, immediate or delayed, maybe from iodoform poisoning, heart failure or some other cause satisfactory to us and easy of explanation to the family. It took our friends of the genito-



urinary specialty, led by Hugh Young, to awaken us to the importance of the work our confrères in physiological chemistry and in medicine were doing.

Recognizing the value of this careful preliminary study we believe that today we are able, barring the "uncontrollable accidents of surgery," to know fairly well what, always in competent hands, will be the probable outcome in any given surgical case. I say probable because we are still fallible in spite of our theoretic perfection of asepsis, of our knowledge of the burden the heart may carry, or of the work the kidneys will do.

The factors concerned in our study vary quite likely in each individual case and in some the preliminary study may be quite exhaustive, may even be repeated time and again along certain lines before the individual is deemed fitted successfully to undergo the operation. Again at times the operation may be done in more than one stage before the complete proposed procedure has been carried out, having in mind always the object of all surgical therapeutics, namely, a living, well patient rather than a brilliant operation and flowers

We will not dwell here upon the routine blood and urine examinations, nor upon the chest examination except to say that no patient with a "cold," however slight, is ever subjected to anæsthesia until all evidence of rhinitis, pharyngitis, or bronchitis has disappeared. Our routine microscopic blood examinations we look upon rather as diagnostic than as having bearing upon outcome.

An hæmaglobinæmia or marked anæmia would necessarily, except in a marked emergency, call for a postponement of operation until a more propitious finding, otherwise a direct transfusion of whole blood from a tested donor would be carried out just previous to operating. In such cases as in all individuals in whom transfusion is contemplated, the heart muscle must be carefully studied as to the burden it will carry. The weak heart muscle of the chronic anæmic may prove disastrous under a rapidly increasing blood volume.

So also, it is rather the poorly functionating heart rather than the organically diseased organ which we fear as an operative risk. Valvular heart lesions compensated for are not to be considered as bad risks but the low pulse pressure heart, the myocardium weakened, as shown by a dilatation or failure to do its work evenly and properly under exercise, is to be looked upon not as a possible but as a probable, dangerous factor. Practically all bad hearts manifest their deficiencies in the output of the kidneys. Therefore, a comprehensive study of the urine should be made. The output of solids as compared with the intake becomes of extraordinary importance to the surgeon, particularly from the standpoint of differentiation between heart and kidney disease.

Our genito-urinary friends taught us the necessity of estimating the functional ability of the kidneys, but there have been times when our simpler test, the phenolsulphonephthalein test, seems to have given us little or no information of any value. Our reliance upon this test alone led us not infrequently into error. So we turned to testing the blood to determine the kidney functionability from the standpoint of retention rather than continuing the urinary study from the excretory side. In this we also found we were at times misled in our interpretations. As a result we have within the past two and one-half years made studies in our laboratory not only from the blood side, namely, of retention products, but conjointly of the output side.

We have no desire, nor is it our intention, to discuss the chemistry or physiology of the methods considered, but rather to give in a concise manner the results of the clinical application of our work in my own operative cases and to other cases which have come under observation for surgical relief and in which operative therapeusis was considered.

Many interesting facts were brought more sharply to our notice in our blood studies, and these seemed to bear out and prove to our satisfaction in a practical way the experimental work previously done by others. For instance a factor to be considered and which, we have learned to know, is not infrequently the cause of death, is that of acidosis. I am convinced that many of our septic appendicitis deaths, as well as those following gall-bladder

surgery and other types of work, ensue from acidosis rather than sepsis as they have generally been construed.

Henderson has shown that there must be certain buffer substances in the blood to prevent destruction of its alkalinity, in fact to maintain the blood at its normal alkalinity. This alkalinity is spoken of as the H-ion concentration, and is represented by a logarithmic notation of 7 which in the blood is very constant at 7.4. Variations in this concentration are of vastly more importance than temperature or pulse variations, and a variation of 0.2 in decrease means the very greatest danger to the patient. We know that individuals cannot live unless the blood be alkaline, and any finding below 7, our notation number, means at once acidity with dissolution if it has not previously occurred. A lessening of these buffer substances of the H-ion concentration, indicates an inability of the blood to carry the most abundantly produced of these acids, viz., carbonic acid, so that here is loss of respiratory stimulation, resulting in rapid diminution of lung ventilation and inability to establish the normal equilibrium of the blood.

It has been shown that the administration of ether causes a constant lowering of the carbonic dioxide capacity of the blood plasma and that the degree of diminution is proportional to the duration of the anæsthesia, the maximum being attained at the close of the anæsthetic, without change for, as a rule, a period of twenty-four hours. Herein we doubtless have the explanation of many deaths without recovery from anæsthetic, in which notwithstanding the postoperative treatment fatality ensues. What then is the remedy for this condition? The answer is careful blood examinations, the recognition of the lowered H-ion content, and the establishment of treatment previous to the administration of the anæsthetic.

Our tables studied in detail present quite a number of interesting points bearing upon the value of these safeguards, and our preoperative preparation with reference to diet, with reference to the anæsthetic, and the time for operation, has constantly in mind the chemical blood findings.

So, also, is the anæsthetic selected, keeping in mind the preceding facts and possibilities; and in our own work we have given the preference to gas-oxygen. Gas-oxygen does not lessen the alkaline reserve in the blood, produces no deleterious effects upon the kidney, does not materially alter blood pressure, and is by far the safest anæsthetic. Occasionally it is desirable that ether in very small quantities should be mixed with the gas-oxygen, but under such circumstances ether is not given for its anæsthetic effect but as a stimulant. Under these circumstances and when given in this way it becomes the most valuable circulatory stimulant that we possess.

The anæsthetist is also a factor not to be overlooked. Gas-oxygen may be and is exceedingly dangerous in the hands of those not trained in its use, and not thoroughly skilled. Ether in skilled hands is to be preferred to gas in those who have not the highest degree of efficiency in this particular mode of anæsthetic. The danger in the administration of ether is in carrying it to the point of saturation, as is done by many so-called skilled anæsthetists. Under such circumstances acidosis is not infrequently brought about, and ether anæsthesia becomes a source of the very greatest danger.

In not a few cases of abdominal surgery, the two-stage operation may be a distinct advantage, and this is particularly true in certain types of supurating appendices, suppurative gall-bladders, gastroduodenal ulcers, and in cancers involving various intra-abdominal organs. The greatest field of usefulness for the two-stage procedures will probably be found in carcinoma of the stomach in those individuals who as a result of starvation have the narrowest margin between the normal alkaline condition of the blood and that of acidosis and in the prostatic with low kidney function and a high degree of nitrogen retention in the blood. There is nothing in the ordinary urinalysis to advise us of early metabolic changes or of early disturbances of renal function, and here again we must turn to our blood study in connection with extraordinary urinary analysis or study.

Formerly much dependence was placed upon the concentration of urea in the urine,

we know now that a lowering of concentration is often accompanied by an increased rate of excretion. In fact an increase in the quantity of urine may mean a deficiency in the concentrating power, especially for nitrogen (1). Whereas the normal kidney will secrete urine containing 1.5 per cent of nitrogen, the granular kidney may at best attain 0.6 or 0.7 per cent. Success then in freeing the body of its nitrogenous wastes is attained by an increase in the urine. In other words where the normal kidney will secrete 1,000 cubic centimeters of urine containing 15 grams of nitrogen, the diseased kidney will be compelled to secrete 2,500 cubic centimeters of urine with a 0.6 per cent concentration to rid the system of 15 grams of nitrogenous waste. It will, therefore, be seen that a lowering of urea concentration in the urine does not necessarily nor likely mean the retention of nitrogenous waste products in the system.

We are presenting in our chart a series of surgical cases in which the newer methods of determining metabolic disturbance and kidney function have been supplied. Under the medical cases are many that reported for some operative procedure, but upon examination were found to be unfit subjects, or suffered from some underlying disturbance that was more serious than the condition for which operation was sought.

It is a well known fact that a disturbance of renal function is a very common accompaniment of disease, particularly after the age of 50, and it is usually the degree of disturbance in the kidneys that makes a surgical procedure more or less hazardous.

Of the methods for investigating renal function, none probably have enjoyed the wide popularity of the phenolsulphonephthalein test of Rowntree and Geraghty (2). This method has been applied to a majority of *our* cases and generally speaking, shows a close agreement with other tests, but as will be shown, it is not infrequently misleading and in a few instances we believe that a new interpretation is needed for results obtained. We believe that this difference is due to the fact that we deal with the introduction of a foreign substance into the body and its elimination cannot always be compared to the elimination of natural waste products. We believe further that in a few instances it acts as a diuretic depending for this action upon renal irritation. We have no other way of accounting for a case in which, after the injection of the drug the two hour output of urine was 800 cubic centimeters and 93 per cent of the drug was excreted. The normal daily output of urine in the same individual was 1600 cubic centimeters. In other words, after the injection of the drug the first two hour quantity of the urine amounted to half the previous total 24 hour output.

The retention of nitrogenous products in the blood above certain figures (3) offers definite information concerning renal function provided we are familiar with the nitrogen intake. It has, however, a negative value under all circumstances. Studies of the urine and blood after the intake of fluid, salt and nitrogen has been carefully estimated (4), shows no definite relationship between the retention of these products and their increase in the blood. The retention of non-protein nitrogen, urea nitrogen, uric acid, sugar, creatinin, etc., have all been studied with the idea of determining renal function (3). In the study of any metabolic process it is always necessary to study three things: first, the food intake; second, the change which it undergoes in the body; third, the excretion of the waste products. A study of any one of these cannot give us very reliable information. Ambard (5) has followed this principle in his study of renal function by determining the maximal concentration power of the kidney. By comparing the concentration of the urea in the blood with the rate of excretion in the urine, the unknown factor is reduced to the rate of blood flow through the kidney and the functional activity of that organ. His laws briefly stated are as follows: First, the rate of urea output varies directly with the square of the concentration of urea in the blood, if the concentration in the urine remains constant. Second, the rate of excretion of urea varies inversely with the square root of the concentration of the urea in the urine, if the blood urea remains constant. The third law combines the first two and is the one generally in use for the determination of the constant. If

the concentration of the urea in the blood and urine varies simultaneously, then the rate of output varies directly as the square of the concentration of urea in the blood and inversely as the square root of that in the urine. By adding correction factors for the patient's weight and for a standard urinary concentration of 25 grams urea per liter of urine he obtained an accurate working formula.

Cathelin (6) opposes the adoption as being unreliable and Addis and Watanabe (7) have attempted to prove that the rate of urea excretion does not depend upon renal function. The work, however, of Lewis (8) and others seems to indicate that their contention is wrong. McLean (9) has substituted new figures for the original which he calls the index of urea excretion. The McLean index is not given in this series, but can easily be applied, if desired. The original co-efficient has been determined in all of the surgical cases in this series and with very few exceptions has been found reliable.

Acidosis, the cause of which has not been definitely determined other than that there is a general impoverishment of the body in bases or in substance which readily give rise to bases (10), has been determined by estimating the hydrogen-ion concentration of the blood (11). Other methods consist of examination of the urine, a study of the products of respiration and the amount of alkali necessary to render the urine alkaline when administered by mouth or intravenously. This latter method we believe to be as reliable as any and simpler of application.

The blood sugar has been estimated in most cases and a hyperglycæmia has been the reason for deferring an operation or for selection of a certain anæsthetic in a number of cases. Of the normal cases in this series, that is cases in which there was no suspicion of any disturbance of renal function, the average for Ambard's coefficient is 0.08, which agrees perfectly with McLean's (9) figures. The average blood sugar in 38 cases considered normal was 0.092 per cent which is in fairly close agreement with other observers.

For the phenolsulphonephthalein the average excretion in normal individuals was 60+ per cent. Our chart shows graphically the relationship existing between the blood urea, Ambard's constant, and the phenolsulphonephthalein excretion, hydrogen-ion concentration and the salt and nitrogen retention, where the nephritic test meal was given. Since this paper and chart show only the value of the various methods when clinically applied, no attempt will be made to account for differences shown in the various tests. Cases 25201, 25120, 25130, 25133 all show high coefficients with the normal or excessive phenolsulphonephthalein excretion. All showed clinically from the urinary analysis the evidence of impairment of renal function, except Case 25173 and in this instance convalescence following operation was very stormy, with pronounced uræmic symptoms. The phenolsulphonephthalein excretion in these cases would seem to be rather an unsafe guide, unless we look upon figures above 75 as indicating renal irritation and hyperpermeability and this we are inclined to do, particularly where there is other evidence that makes kidney permeability questionable. It might be contended that in these few cases the phenolsulphonephthalein excretion showed the true kidney function while the Ambard constant was faulty. To which we would reply that the other evidence from physical examination and the postoperative symptoms would indicate that the phenolsulphonephthalein excretion was not an index to the true functional capacity of the kidney. Attention has previously been called to such cases (13) and the belief expressed that there may be a stage in nephritis when hyperpermeability exists (14), at least, to phenolsulphonephthalein and some other substances. We have come to look upon an output of more than 75 per cent of the injected drug in two hours as being decidedly suggestive of renal disturbance with irritation where there is other evidence to indicate the same. Cases 25010, 25143, 25190 all have normal coefficients but with low phenolsulphonephthalein excretion, yet in all the convalescence was uneventful. It would seem from this limited number that a low phenolsulphonephthalein excretion is not always a contra-indication to surgery nor a true guide to the functional capacity of the kidney.

Case 25191 is rather interesting in this connection, showing an increased constant with an adequate phenolsuphonephthalein excretion at the time of operation Following operation convalescence was very stormy with symptoms of uræmia pronounced, and with improvement came a decided lowering of the coefficient but contrary to what would be expected a decrease in the output of phenolsulphonephthalein. A discussion of the reason for this phenomenon is out of place here but the fact is significant. There seems to be no definite relation existing between the blood urea and the coefficient of Ambard. We would particularly call attention to Case 25733, which is an exception to the general rule and also to the law of excretion. Corresponding to the high blood urea content with a high urea constant was a high urea concentration in the urine and a greatly increased rate of output, thus making a normal constant of .077. This figure was misleading as a prognostic sign, since convalescence was very stormy and presented decided uræmic symptoms for a week or more. We believe that a high coefficient of Ambard deserves great consideration even in the presence of a normal blood urea but on the other hand we believe that a *high blood urea content* is extremely significant regardless of the constant or the phenolsulphonephthalein excretion. Such a combination will rarely occur however.

There is nothing of particular interest in regard to the blood sugar in these cases other than that in a few medical cases of Bright's disease, a disturbance of renal permeability for sugar is shown.

In concluding we would say that generally speaking there is a close agreement between blood urea, Ambard's constant and the phenolsulphonephthalein output. The few exceptions, as far as clinical results are concerned, would indicate that the coefficient of Ambard is a greater prognostic value than the phenolsulphonephthalein excretion, since in the several cases cited where the Ambard constant was normal and the phenolsulphonephthalein output was low, convalescence was uneventful and on the other hand with normal or increased excretion of phenolsulphonephthalein and increased constant, convalescence was usually more or less stormy. We would furthermore attach importance to a phenolsulphonephthalein excretion about 75 per cent, where there is further evidence of disturbed function. This is particularly true of tuberculous infection of the kidney.

A high urea content of the blood demands serious consideration regardless of other tests. In this connection it is well to mention the fact that Lewis (8) has demonstrated that in cases of nephritis with high blood ureas and high constant of Ambard, while the blood urea may be reduced to practically normal by careful diet, this decrease is accompanied usually by an increase in the coefficient, indicating no improvement as far as function is concerned.

CONCLUSIONS

From the numerous investigations concerning the condition of acidosis, renal function and the retention of protein products in the blood, all of which are determined for the purpose of ascertaining disturbances of metabolism, we are justified in drawing the following conclusions: A patient is not in the best possible condition to undergo any surgical procedure when he has—

1. A hydrogen-ion concentration of his blood below pH 7.35.
2. A carbon-dioxide tension in the alveolar air below 35.
3. A soda tolerance test above 15.
4. An Ambard coefficient above 0.10.
5. A urine which shows but little variance in quantity from day to day and with the specific gravity varying less than 7 points regardless of the intake. Also nocturnal polyuria.
6. A phenolsulphonephthalein output below 40 unless it can be accounted for by disease of other organs, the liver particularly.

We feel that we can best conclude this article by quoting verbatim from Koshiro Nakagawa (15).

1. A normal constant does not necessarily imply freedom from disease but does indicate compensation of the renal defect.
2. An increased constant indicates impairment of function.
3. Particular diagnostic significance in tuberculous kidney: Normal constant suggests

only one kidney affected. Increased constant indicates both kidneys or that it is associated with toxic nephritis of opposed kidney.

4. In disease of lower genito-urinary tract an increased constant means impairment of renal function. This may be due to co-existent renal disease or to some obstructive or infective process in the lower urinary passage. In such cases, if the bladder is drained a few days before adopting more radical measures, and the constant approaches normal, it would indicate purely secondary disturbance of kidney, whereas if it remains constant it would mean a gross kidney lesion in connection with other pathology and points out the danger that may attend further operative measures.

5. Entails no discomfort to patient. Infection or ingestion of foreign substances is not required, nor is it necessary to control diet. It is applicable where ureteral catheterization or examination of lower passages is impossible.

6. Information as to state of renal function gained by urea in blood is amplified and completed by determination of Ambard's constant.

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Non-protein nitrogen in the blood. Folin, J. Biol. Chem., 1912, lxi, No. 5. A combination of heat and air current was used for transferring the ammonia to the acid solution.

Uric acid in blood. Benedict's method. J. Biol. Chem., xx, No. 4.

Blood sugar. According to the Lewis and Benedict method as modified by Meyers and Bailey, J. Biol. Chem., 1916, xxiv, No. 2. In many instances both methods were used and checked against each other and the results were the same in every instance. The Meyers and Bailey method was then accepted and used throughout. A standard glucose solution was used in place of picramic acid solution, against which the unknown was compared.

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BILOCULAR (HOUR-GLASS) STOMACH

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BILOCULAR stomach is characterized by a mediogastric constriction like that of an hour-glass. The organ is thus divided into two pockets, an upper or cardiac pocket and a lower or pyloric pocket. These two pockets communicate with each other by an orifice or passage-way.

ETIOLOGY

The biloculation may be temporary or permanent. When temporary it is due to a spasm which momentarily constricts the stomach in the center. When permanent it may be due to a permanent spasm which occurs at the level of an ulcer in process of evolution or to the retractile cicatrix of an ulcer on the lesser curvature. The ulcer may provoke this mediogastric stenosis in several ways:

1. By spasm, an annular contraction of the surrounding layer of muscle at the level of the ulcer. An indentation is formed on the greater curvature opposite the ulcer of the lesser curvature.

2. By hypertrophy, an induration of the gastric walls. The ulcer becomes "callous," its edges are hard, or sometimes it is accompanied by perigastritis and becomes surrounded by cicatricial adhesions. The subserous and submucous thickenings become indurated, immobilizing the central portion of the organ between the two supple and contractile gastric pockets.

3. By cicatrization of the ulcer and fibrous retraction of the cicatrix, a retraction which involves the submucosa and the musculature.

We have operated by resection upon 23 cases of mediogastric stenosis which were not cancerous; in only four instances have we noted in the course of the operation that "healing" of the ulcer in the form of an annular, fibrous cicatrix between two gastric pockets with normal and supple walls. In 9 cases there was a non-cicatrized ulcer in the process of development. In 10 cases a perforating ulcer in the process of evolution had destroyed the stomach wall and penetrated into the neighboring organs, the liver, pancreas, and abdominal wall.

PATHOLOGIC ANATOMY

Mediogastric stricture. This is situated in the central portion of the lesser curvature, the usual site of ulcer. In fact, in 20 ulcers of the stomach, 19 were located on the lesser curvature. The ulcers called "pyloric" are either duodenal ulcers or ulcers of the lesser curvature which extend on to the pylorus or the walls of the stomach but always have their primary location on the lesser curvature.

The stricture has the form of an incomplete ring; the circle is broken at the greater curvature. Most often it is grooved and is several centimeters in length. The strictured channel is generally eccentric and near the lesser curvature. Toward the peritoneum the stenosis is indicated by a puckered cicatrix which is pearly white and may or may not be hidden by the lesions of perigastritis. In the majority of cases of mediogastric stricture we have found a perforating ulcer penetrating into the pancreas, the liver, or the anterior abdominal wall, and occasionally into two or three organs at once. In such cases operated upon by us there remained after the gastrectomy a complete pyloric pocket and a narrow ring coming from the cardiac pocket. This ring was joined to the lower pocket by a narrow band of healthy stomach tissue which represented the greater curvature. The stricture itself no longer existed and the intermediate zone between the two pockets was formed by the neighboring organs which had been invaded by the ulcer.

In the majority of these cases, therefore, the stricture is not formed by a true cicatrix but by fully developed perforating ulcers.

The cardiac pocket. The cardiac pocket is generally the most voluminous; it is volumin-

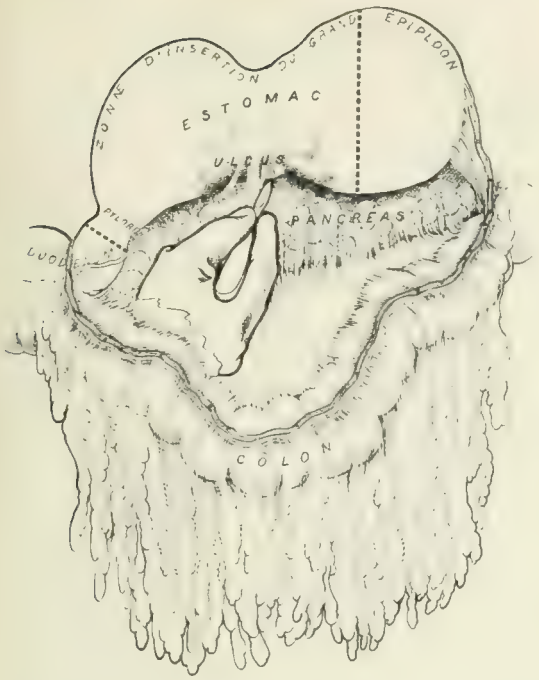

Fig. 1. Most often bilocular stomach is caused by a callous ulcer still in the process of evolution, sometimes perforating. Therefore it should be treated as an ordinary ulcer, that is to say, by hemigastrectomy. The stomach has been stripped of its omentum by means of a compress (Temoin). The dotted line represents the portion of the stomach which is to be resected (hemigastrectomy). The bistoury separates the ulcer and the pancreas.

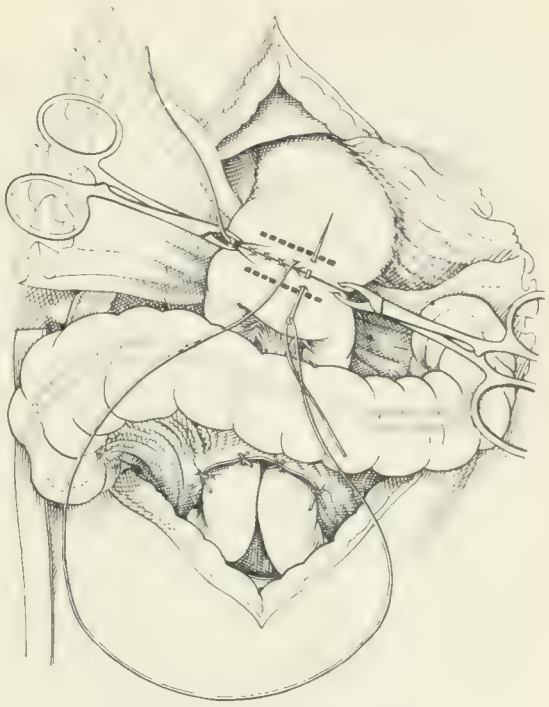

Fig. 2. Hemigastrectomy. Anastomosis of the upper pocket with the jejunal loop. Here as a result of the retraction of the upper pocket it is not possible to bring the gastric opening into contact with the gastrojejunal anastomosis. In order to close it, four sutures hold it to the jejunal loops.

The anastomosis unites the anterior wall of the stomach and the jejunum. It does not make any difference whether the anastomosis is done to the anterior or the posterior wall of the stomach. The choice should depend upon which can be done most easily. As the stomach then forms a cul-de-sac, one is sure that the anastomosis will be made at the lowest point by choosing the portion which can be drawn out most easily.

ous for two reasons; first, because the stricturing ulcer of the lesser curvature is nearer the pylorus than the cardia, and second, because the stasis of food has distended the upper pocket. The topography of the cardiac pocket is variable. In high position, the large tuberosity rises into the dome of the diaphragm above the cardia. In low position the greater curvature falls, dilates into a cul-de-sac, and is displaced toward the right, and in that case accentuates the stenosis. Occasionally we have found the cardiac and pyloric pockets of equal size; the stricture was then higher. In 4 cases the cardiac pocket was small and after gastric resection we experienced the greatest difficulty in implanting the end of the stomach into the jejunum.

The pyloric pocket. This is generally smaller than the cardiac pocket, but we have found it dilated in cases in which there was simultaneously a stenosis of the duodenum, a quite common complication.

Varieties. Beside the common form of hour-glass stomach described we have observed the following varieties: (a) mediogastric stenosis co-existent with duodenal stenosis; (b) stenosis accompanied by a perforating ulcer penetrating the abdominal wall, the liver, or the pancreas; (c) cancerous degeneration of a stenosing mediogastric ulcer; (d) perigastric abscess around a stenosing ulcer; (e) gastrocolic fistula in the strictured area.

SYMPTOMS

1. *Antecedents of gastric ulcer.* The classical syndrome of ulcer (vomiting, pain, hæmorrhage is exceptional. As has been shown by Mayo and Moynihan, gastric or duodenal ulcer is evidenced in the majority of cases by the painful phenomena of hyperpeptic gastritis (acid regurgitation); these disorders are decreased or aggravated by food; soothed by the bismuth régime. Their evolution is accompanied by remissions simulating cure, with periods of recrudescence. The longer the malady continues the shorter the remissions become and the greater the gastric distress. In fact, usually most of those who have gastric ulcer lead an ordinary life and are considered as "dyspeptics" or "neurasthenics," who are reconciled to their functional troubles.

2. *Painful phenomena.* The painful phenomena are due, not to the mediogastric strangulation, but to the chronic ulcer which has produced the stenosis. If the ulcer is perforating, it causes pain; often this pain is continuous throughout the day from the first meal and causes a paroxysm at each attempt to take food. Sharp epigastric and dorsal pain (*en broche*) is frequent and often accompanies perforating ulcer of the lesser curvature. These pains are variable and in the interval between the attacks are bearable. The vomiting does not relieve the pain. Food and diet relieve it slightly.

3. *Vomiting* is the rule; it is frequent, repeated, and due, not to the stenosis, but to the ulcer. If it occurs at intervals, is regular and copious, it is then due to the stenosis and represents the evacuation of the distended cardiac pocket. At first, the vomitus is mucous, but later it contains and continues to contain food; on the whole, this syndrome does not differ from that of ordinary pyloric stenosis.

4. *The general condition.* Emaciation, asthenia, and anæmia follow the hunger cachexia due to the stenosis, whether this stenosis is pyloric or mediogastric.

5. *The physical signs. A. Inspection and palpation* do not differentiate pyloric stenosis from mediogastric stenosis; distention, dilatation of the stomach, and peristaltic contraction appear at the moment of the pain as in stricture of the pylorus. The presence of a mass is due to a callous ulcer with perigastritis.

B. Examination with a sound. Intubation after fasting without lavage 12 hours after the last meal makes it possible to evacuate food residue as in cases of pyloric stenosis.

C. Intubation with lavage of the stomach reveals the following three phenomena which are of value chiefly from the point of view of diagnosis: (a) The lavage water returns only in part as it has passed into the pyloric pocket beyond reach of the evacuating tube. (b) Lavage is being accomplished normally and the liquid is returning as it entered when suddenly a cloudy fluid is obtained which contains particles of food; these come from the pyloric, pocket the contents of which have re-flowed through the mediogastric orifice. (c) The stomach is washed and well emptied by the sound; percussion still elicits a splashing sound. the location of which is in the pyloric pocket which has not been emptied and which alone gives forth this sound

D. Insufflation of the stomach. When the stomach is distended two different results are observed. The entire stomach becomes filled with air; its outline can be made out by percussion or inspection in the form of two sonorous zones separated by a band of dullness (Gaston Lion).

Only the cardiac pocket is filled and becomes sonorous in the left hypogastrium; the lower pocket remains dull and gives forth a splashing sound (Bouveret). By the splashing sound it is possible to determine the lower limit of the stomach. The test should be repeated a few minutes later. In one minute the condition may change; the cardiac pocket is less distended and the pyloric pocket is sonorous; the air has passed through the stenosis, making a gurgling sound in rhythm with the respiration.

E. Radioscopy gives valuable information; it should be used 12 hours after a bismuth meal. The normal stomach viewed from the front has the form of the letter J; its upper portion forms clear lines separated by the opaque contents; a few spoonfuls of fluid are sufficient to fill it in the vertical direction; it then does not dilate except in a vertical direction and maintains its regular caliber.

The bilocular stomach has a characteristic appearance; sometimes this consists of two dark images united by a dark narrow band; this is a shadow in two parts which are disposed on a vertical axis or, rather, an axis that is slightly oblique, downward and to the right; sometimes there are two distinct shadows, an upper one on the left side in the form of a cone with an air chamber, and the other, a lower one to the right which is separated from the first one by a gap. This second pocket forms a segment of a circle with its convexity downward; it does not have an air chamber during the filling of the stomach. The pyloric pocket does not cast a shadow until several minutes after that of the cardiac pocket. Under the pressure of the finger the two gastric pockets are movable with reference to each other. The shadow never resumes the form of the normal stomach when the base of the organ is raised. It is impossible to empty the cardiac pocket into the pyloric pocket or to cause the liquid to flow back from the pyloric pocket toward the cardiac pocket. Often a diverticular formation is observed in the lesser curvature. This represents a perforating ulcer which is being filled with bismuth.

The true bilocular stomach should not be confused with the bilocular image of the ptotic stomach. The latter is characterized by the manner in which it fills. While the normal stomach becomes enlarged gradually as it is filled and its upper level remains constant, the ptotic stomach becomes filled like an inert sac; its breadth in the dependent portion reaches its maximum at once; its upper level gradually rises as the liquid is swallowed; the stomach becomes elongated under the weight of the fluid and as a result of this weight, it becomes strangulated in the center and thus resembles a bilocular stomach.

Neither should the true bilocular stomach be confused with the mediogastric spasm which causes a bilocular image but an image which changes or disappears in the course of repeated examinations or under the influence of atropine. Certain spasms are tenacious and persistent even when studied at several examinations; these unyielding spasms are then due to an organic cause and occur in the presence of a chronic ulcer; but if it is a case of a bilocular image due to mediogastric stenosis or a permanent spasm in the presence of a chronic ulcer, the error is not of much importance since the treatment of an ulcer in the process of evolution is the same as that of an established stenosis.

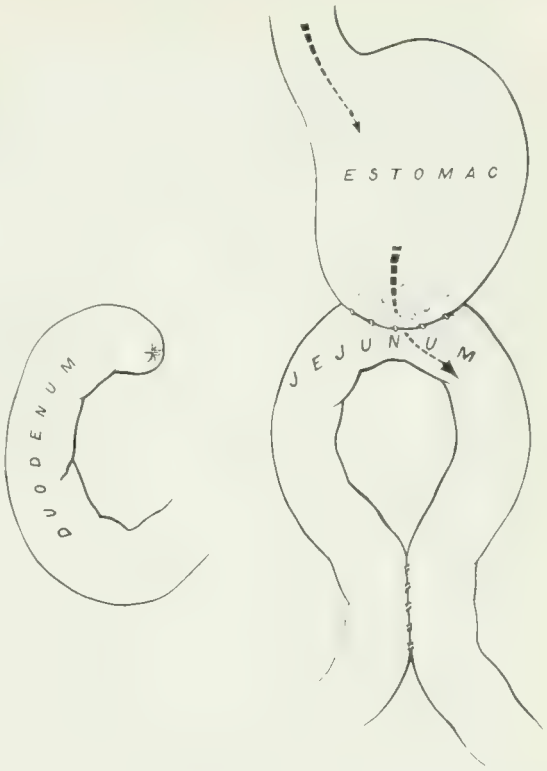

Fig. 3. Hemigastrectomy. Gastro-enterostomy. The gastric pocket is retracted; the jejunum has formed an angle at the level of the anastomosis and it has appeared advisable to the surgeon to do a jejunojejunostomy which permits the passage of the biliary and pancreatic fluids into the efferent loop.

SURGICAL TREATMENT

We reject gastroplasty and gastro-enterostomy; these two operations have given us good immediate results but have been followed by conditions which necessitated new interventions. On the basis of my personal experience, these two operations should be rejected.

Three operations are being advised: gastro-enterostomy, mediogastric resection; and pylorogastrectomy.

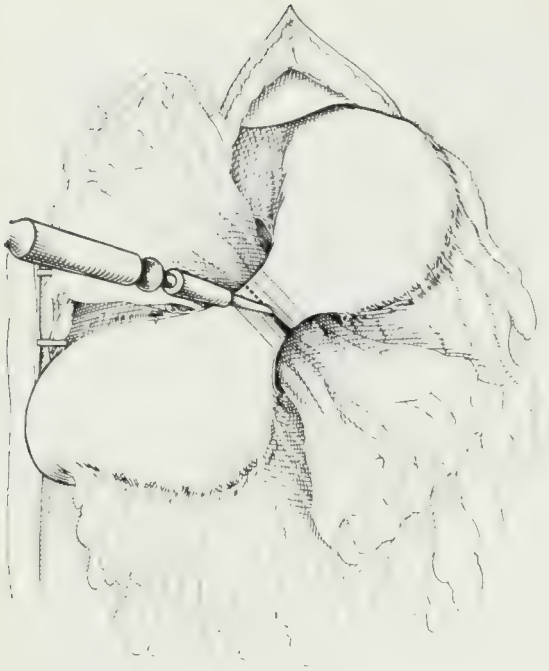

Fig. 4. Division and gastro-enterostomy. Narrow stenosis; ulcer completely cicatrized; an unusual but very favorable case. The ecraseur has crushed the retracted portion of the stomach as far as the healthy walls. The cautery is sectioning the crushed portion which is to be closed with a purse-string suture.

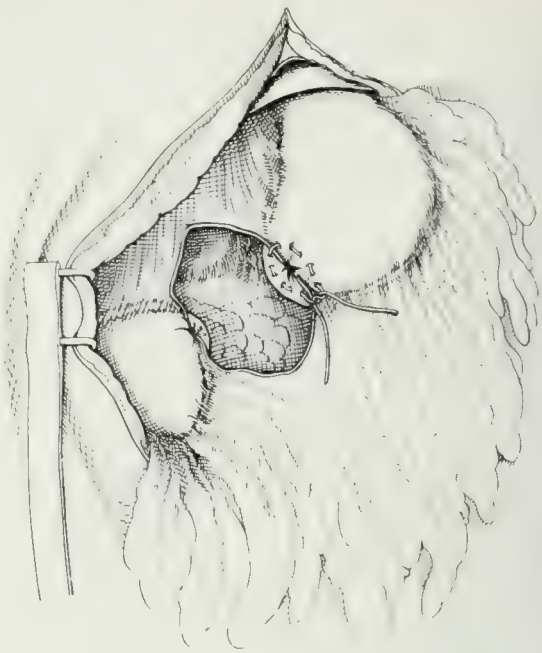

Fig. 5. Crushing and gastrojejunostomy. Closure of the two ends with a purse-string suture and gastrojejunostomy. The lower pocket remains.

Gastro-enterostomy. The surgeon makes an anastomosis between the upper pocket and the jejunum as if it were a case of stenosis of the pylorus. Very often because of the high position of the upper pocket the anastomosis forms a "kink" in the afferent intestinal loop and drainage is retarded. If, therefore, there is a "kink" the surgeon completes the gastro-enterostomy by a jejunojejunostomy. Often the ulcer continues to develop in spite of the anastomosis and again causes trouble. The surgeon is then forced to do a secondary gastrectomy. Why should not this pylorogastrectomy be done immediately? Because in some instances the patient is cachectic; it is necessary to do the operation in two stages, beginning with a gastro-enterostomy and performing a gastrectomy six weeks later. The patient stands the secondary resection very well and becomes definitely cured.

Mediogastric resection. To resect the strictured gastric segment or the gastric segment which has indurated walls. Annular resection of a portion measuring two or three inches is sometimes sufficient but more often it is necessary to sacrifice a greater area of the stomach. To accomplish such a resection the best procedure is as follows: Holding the stomach with the left hand, the surgeon wipes the greater curvature forcibly with a compress in the right hand to strip it of the greater omentum. He then strips the lesser curvature in the same manner. In this way he frees a strictured segment of the stomach which is ulcerated or perforated and completely stripped of its two omental coats and well isolated from the supple portion of the two gastric pockets. The diseased zone is crushed and resected.

How should the two healthy extremities of the stomach be treated? Close the two gastric ends with a purse-string suture and finish by making an anastomosis of the upper pocket and the jejunum.

Pylorogastrectomy or hemigastrectomy. This is the operation of choice. It consists in liberating the stomach on its two curvatures

by stripping with a compress. This stripping is continued as far as the duodenum which will be crushed with a Mayo, Gudin, or Thierry de Martel ecraseur and closed with a purse-string suture. The liberation is continued toward the cardia; the surgeon proceeds as far as the upper pocket which will be freed for a distance of several centimeters and closed with a purse string suture; a gastro-enterostomy re-establishes continuity.

If this upper pocket is small, side-to-side anastomosis with suture is impossible; the surgeon will then be able to choose between two procedures: either to leave the end of the stomach open and implant it directly into the jejunum in order to save several centimeters of stomach; or to insert one-half of a Murphy button in the upper end of the stomach and close it with a puckering suture; insert the other half of the button in the jejunum and close it also with a puckering suture. By an opening made with the cautery form a gastro-enterostomy.

These two procedures are good.

I had the opportunity to operate upon 25 and to resect 23 bilocular stomachs. These operations were divided as follows: 1 gastroplasty; 2 gastrogastrostomies; either alone or associated with a gastro-enterostomy; 4 mediogastric resections; and 18 pylorogastrectomies. I have re-operated upon two patients upon whom a pyloroplasty, gastrogastrostomy, and gastro-enterostomy had been performed. These patients were obliged to submit to a secondary gastrectomy for functional trouble. These operations resulted in two deaths; one case was complicated by a perigastric abscess and in the other there was an extensive perforating ulcer.

These operations were performed under regional or spinal anæsthesia with or without several whiffs of nitrous oxide for several seconds.

The extensive resections have given by far the best end-results.

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BONE CHANGES IN WAR AMPUTATION STUMPS*

By THOMAS G. ORR, M.D., Kansas City
Major, Medical Corps, U. S. A.

THE X-ray has shown some very interesting and unusual bone changes in the stumps of war amputations. These changes have been mainly due to the method of amputation so much used at the front. A very large percentage of the cases was done by the "guillotine" or flapless[1] method. A somewhat smaller percentage was done with flaps which were not sutured primarily but were often packed open or stitched back on the stump to facilitate drainage. In all of these amputations the bone was exposed to injury and infection producing conditions that rarely occur in the average case in civil practice.

In a review of more than 400 roentgenograms, the principal changes observed were spur formation, formation of sequestra, proliferation of bone, periosteal thickening, and, in a great many cases, marked rarification. Of these the chief interest lies in the spur and sequestra formations.

Spurs may project from almost any portion of the bone end but are least common on the cut surface. In the thigh the most common location for these bony growths is on the inner surface near the end and projecting upward into the adductor muscle or toward the sheath of the femoral vessels. They also very frequently project from the linea aspera. In the lower leg there does not seem to be

[1] Orr. The guillotine amputation. Ann. Surg., 1919, lxix, 513.

* From the Orthopedic Service of the U. S. General Hospital No. 26, Fort Des Moines Iowa.

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Smooth healing of stump without bony change.
Fig. 2. Arm stump showing marked rarification of bone from prolonged disuse. Healed without infection.

Fig. 3. Shows convex shell of bone that sometimes covers the medulla during healing.

any particular location for their formation. This is also true of the upper extremity. They not infrequently follow sinus tracts leading from sequestra (Fig. 9).

Shredding or tearing of the periosteum and infection are probably the chief causes of spurs. In war amputations infection undoubtedly plays the chief rôle. Bone reacts

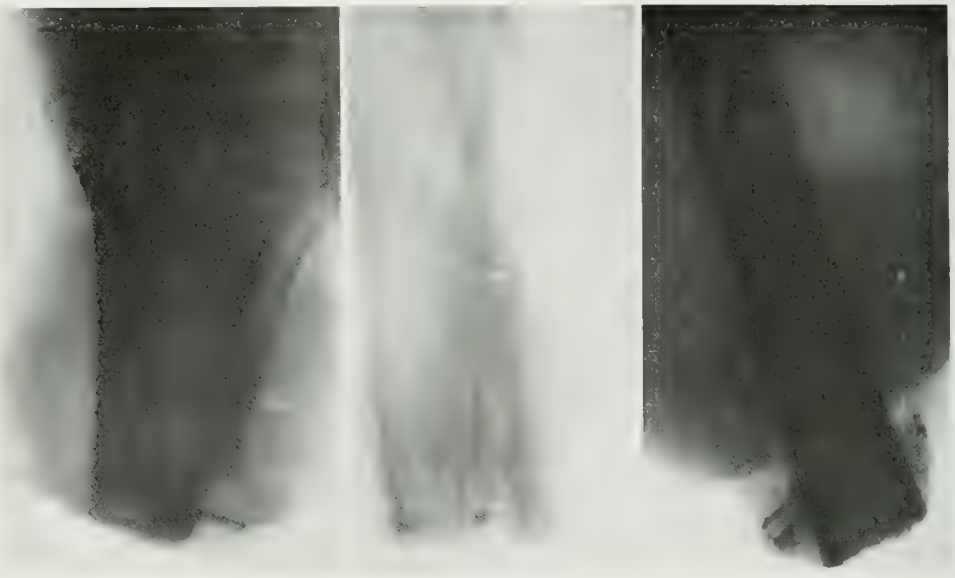

Fig. 4. Fig. 5. Fig. 6.

Fig. 4. Small spurs projecting from both tibia and fibula. This type of spur probably due to stripping up and shredding of periosteum.

Fig. 5. Ascending osteomyelitis of short femur stump. Note beginning sequestrum formation. Of 500 amputation cases this was the only example of so extensive an ascending infection.

Fig. 6. Lateral spur formation with marked retraction of muscle from the stump end.

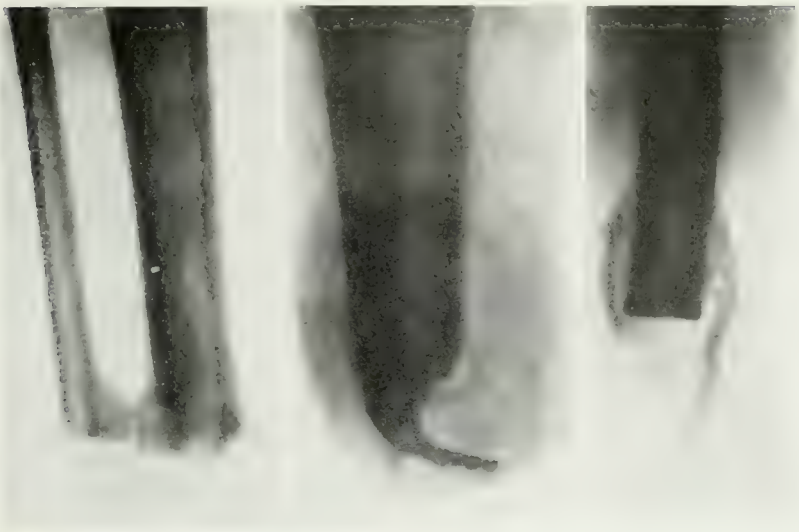

Fig. 7. Fig. 8. Fig. 9.

Fig. 7. Synostosis between tibia and fibula and tibial spur following "guillotine" amputation of the leg.

Fig. 8. Spur attached to the end of amputated tibia following an infected stump.

Fig. 9. The result of an infected arm stump. A sequestrum composed of the entire end of the bone has separated. Two slender spurs have grown along sinus tracts through redundant soft parts.

to infection in two ways that are directly opposed. The bone is either destroyed or it proliferates. It is very easy to see how torn periosteum could produce spurs like those in Figure 4 but not those in Figures 8, 9, 10, and 11. In the latter four cases infection exist-

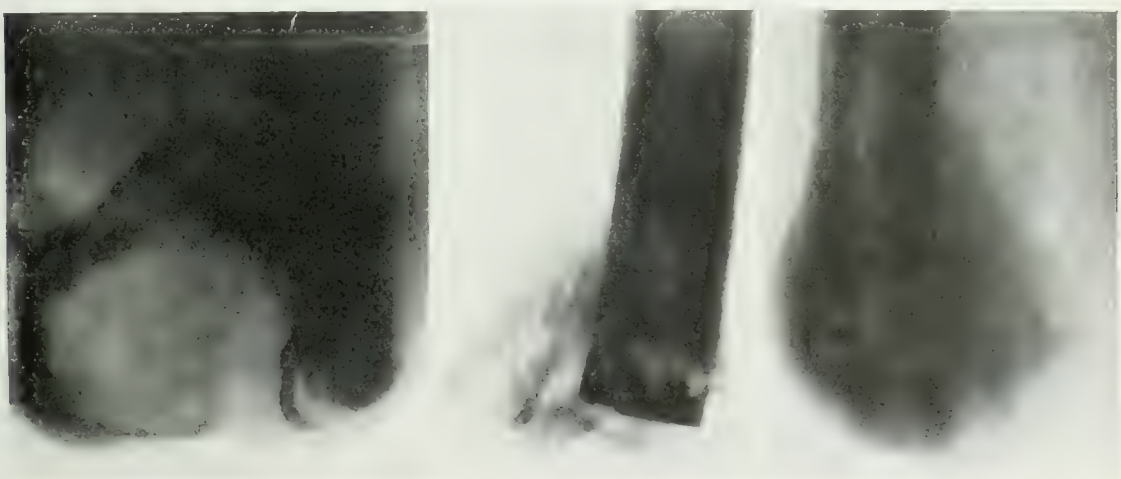

Fig. 10. Fig. 11. Fig. 12.

Fig. 10. Large spur extending into adductor intermuscular plane from a short femoral stump.

Fig. 11. Complete ring sequestrum separated from the end of a femoral stump. The fan-shaped spur formation extends into the adductor muscles. This spur was the result of an infected stump which followed a "guillotine" amputation.

Fig. 12. Complete ring sequestrum surrounded by new bone formation as result of infected "guillotine" amputation. Stump healed except small sinus from sequestrum.

ed for several weeks or months resulting in marked bone proliferation. The extensive spur shown in Figure 10, suggests the bone formation of myositis ossificans traumatica. These large spurs in the adductor region tend to follow the fascial planes very much as does the bony outgrowth of the familiar "rider's bone."

In a very large percentage of the cases spurs have not interfered with successful fitting of artificial limbs. If they are in a location where there is very little friction or pressure they will not cause any symptoms. Bursæ rapidly form over the spur ends permitting the overlying tissues to move freely. The presence of a spur, even of considerable size, is not an indication for operation unless it produces symptoms after a trial-fitting with an artificial limb.

Ascending infections of the bone following amputation have not been very common. In a series of 500 cases, there was but one with an ascending osteomyelitis (Fig. 5). In this case a thin shell of sequestrum formed which extended up the femoral shaft about 7 centimeters. This was removed and sound healing followed in a few weeks.

Sequestra are quite common in the open amputation. Here the bone is very apt to be deprived of its nutrition and become necrosed. The complete ring sequestra that so frequently occur (Fig. 11) may be due to the destruction of blood supply to the bone by the much used aperiosteal method of amputation. The periosteum and endosteum are removed for a varying distance from the end of the bone leaving it exposed to infection without its normal blood supply. Small sequestra often become almost or completely surrounded with new bone and may entirely heal over and remain healed for several months. Any irritation may light up an infection and form an abscess. This is one very important reason why all amputation stumps should be roentgenographed as a routine measure.

CYSTICERCUS RACEMOSUS (TÆNIA SOLIUM) INFECTION OF SPINAL CORD

With Report of Case

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First Assistant Visiting Surgeon, Boston City Hospital

THERE occurred on my service, in the Boston City Hospital, referred from the neurological service of Philip Coombs Knapp, who had localized the tumor and requested that the patient be operated upon, an unusual and interesting case of cysticercus racemosus (tænia solium) which deserves recording because of the location of the cyst in the spinal cord, a situation where such cysts have been found but rarely.

I believe this case to be unique because of the extreme rarity of tænia solium in this country and because, so far as I know, it is the only case where a pork tapeworm has been removed successfully from the spinal cord during life. William H. Mercur, of Pittsburgh, I believe, found a similar tumor of the spinal cord, but at autopsy.

For the following, with pathological report and microphotographs, I am greatly indebted to F. B. Mallory:

Tænia solium is a tapeworm which occurs in man only. Its mature segments produce large numbers of ova which are voided in the fæces. Ingested frequently by the domestic hog, less often by other animals, the ova develop, invade the tissue and give rise to an intermediate form known as cysticercus. If incompletely cooked pork containing a cysticercus is ingested by man it will develop into a tapeworm, tænia solium, or by vomiting as a result of which ripened segments of the tapeworm or ova which have been discharged into the intestinal contents gain entrance into the stomach.

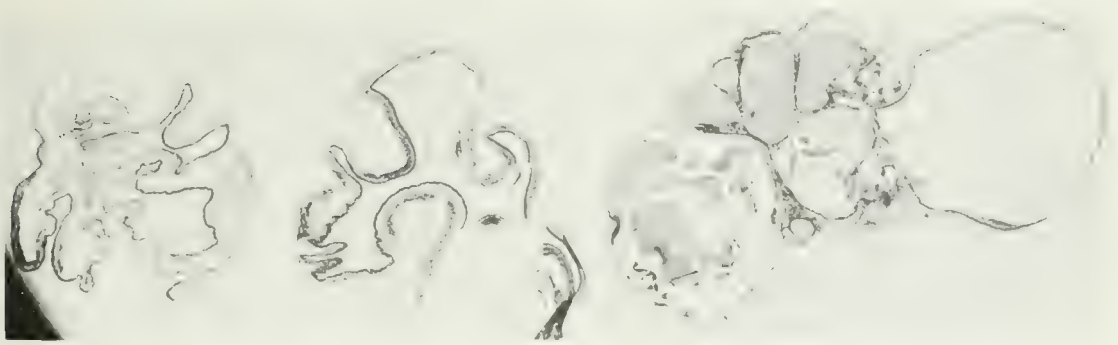


Fig. 1. Sections through three different parts of the specimen.

The tapeworm, tænia solium, ordinarily attains a length of 2 to 3 meters, but occasionally grows to be 6 or even 8 meters in length.

The cysticercus stage (cysticercus cellulosæ) as it lives in the intermuscular connective tissue and other tissues and organs of the domestic hog occurs as an elliptical vesicle 6 to 20 millimeters in length and 5 to 10 millimeters in diameter.

In man the cysticercus frequently occurs in the brain, where, owing to its irregular lobular shape, it is commonly called cysticercus racemosus. As many as 60 to 100 have been found in a single brain. They are very rarely found in the spinal cord.

Infection with tænia solium, or with its intermediate form, cysticercus cellulosæ, is rare in the United States.

The surgical specimen (S18.307), received at the laboratory consists of an elongated, thin-walled translucent cystic structure measuring 5.5 centimeters in length by 1 centimeter in greatest diameter. The upper end is formed by an oval cyst a little over 1 centimeter in greatest diameter. Joined to this is a second cyst a little smaller in size, in which 5 to 6 much smaller cysts can be seen. The rest of this specimen is a folded membrane 3.5 centimeters in length by 2 to 3 millimeters in diameter, which is evidently the wall of a collapsed cyst.

Microscopic examination shows the walls of the cysts to be composed apparently of connective tissue in which are numerous deeply staining (contractile?) fibrils. The cysts contain homogeneous or finely granular material: in some of the cysts it stains intensely with alum hæmatoxylin. The outer wall of some of the cysts is thrown into minute papillary projections and is lined apparently with minute cilia. Diagnosis: Cysticercus racemosus. (tænia solium.)

REPORT OF CASE

M. K., a Russian, male, age 25, was admitted February 1, 1918, to the Boston City Hospital Nerve Service of Philip Coombs Knapp.

Past history. Pain, constant and dull, began in both sides of his chest in the winter of 1916. Since then the pain was intermittent until January 20, 1918, when it became continual. Since October, 1917, his feet have been cold and numb, he could not walk straight, and he became tired easily. He had some weakness of legs and atrophy of left quadriceps.

Sensory symptoms. Anteriorly, hyperæsthesia and hyperalgesia from seventh intercostals downward to both feet, but more marked on the right. Posteriorly, the affected areas reach over the right side from the level of the ninth dorsal spinous process, and over the left side from the first lumbar spinous process toward the feet.

Reflexes. Arms normal. Absent epigastrics, abdominals, and cremasterics. Knee jerks lively. Double patellar clonus. Very lively Achilles jerks. Double Babinski. Moderate ataxia, most marked between heel and knee. *Knocking over fourth and fifth dorsal spinous processes with hammer causes pain; causes no pain over the remaining processes.* (Note location of tumor at operation.)

The patient was transferred to first surgical service with request by Dr. Knapp that he be operated upon, and with expectation of finding spinal cord tumor at fourth or fifth dorsal segment.

Fig. 2. The most solid part of the cysticercus.

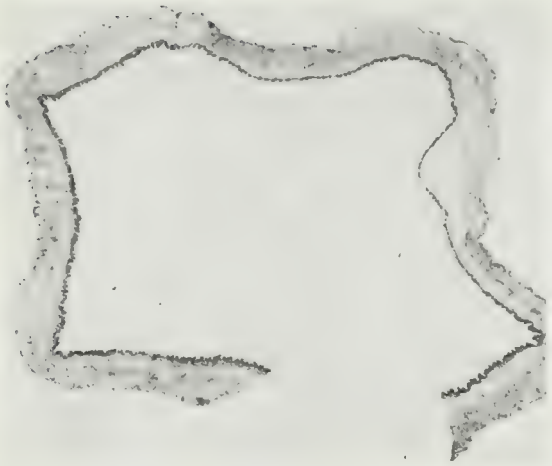


Fig. 3. The cyst wall turned inside out, showing the characteristic wavy external surface.

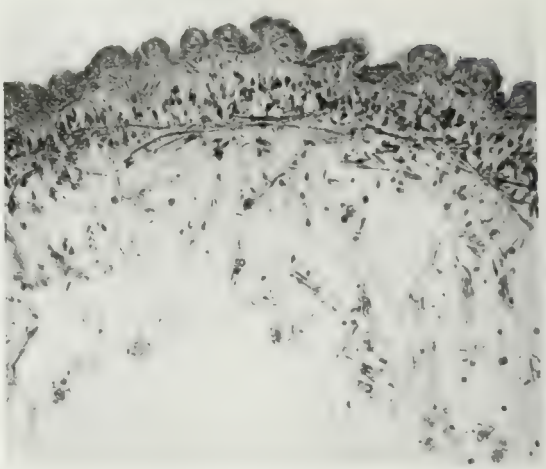


Fig. 4. High power view of cyst wall seen in Fig. 3, showing more perfectly the undulating external surface and the contractile fibrils in the underlying tissue.

Operation, March 6. There was nothing unusual about the technique of the operation, except that it was difficult because of the region. Laminectomy was done upon the fourth, fifth, and sixth dorsal vertebræ and the cord exposed. Between the fourth and fifth dorsal vertebræ there was a distinct difference in the tension of the cord. The tension appeared to be greater, and the cord was paler in this region. This was difficult to demonstrate to onlookers, but to the operator the difference in tension was very marked. The cord itself was now exposed and split longitudinally with a very small thin bladed knife. This revealed the translucent tumor described in the pathological report. With the little finger the tumor was easily shelled from the cord. It appeared as a gelatinous mass. Its gross appearance was entirely new to all who witnessed the operation and to myself, and no one had any idea of its nature until Dr. Mallory enlightened us. The membranes were now closed with the usual closure of a laminectomy wound.

Findings at examinations by Dr. Isador H. Coriat of the neurological service. March 9: Moderate priapism, no paralysis of diaphragm or respiratory muscles. All but a few upper abdominals absent. Cremasterics absent. Knee jerks diminished with slow reaction time, flaccid paralysis of both legs, right plantar reflex absent, slow Babinski on left, and complete loss of sensation below lower border of eleventh dorsal vertebra. May 14: Cremasterics returned. Knee jerks present and livelier on left. Achilles jerks present. Plantars very sluggish. Sensation reappeared on left outer calf. (Patient sent home.) July 30: At patient's home. (At this time the patient had shown a remarkable improvement both neurologically and as to his general condition.) The patient was on an air mattress. He was incontinent, although he could tell when he passed his urine. He could flex toes of his left foot. He had contracture of the Achilles tendon. Knee jerks normal. His right plantar reflex was absent, the left normal. Abdominals and cremasterics absent. He had *superficial small bed sores.* He could turn over in bed although he could not move his legs. There was analgesia and anæsthesia below twelfth dorsal segment. His general condition was much improved however.

A very short time after Dr. Coriat's visit to the patient at his home, he was readmitted to the first surgical service with extremely bad bed sores and a severe gastro-intestinal upset with great distention. This distention was relieved by enemata. He continually grew worse and died August 15, 1918. Unfortunately, autopsy could not be obtained.

Fig. A.

Fig. B.

Fig. C.

Fig. D.

Fig. A. Case 1. Showing loss of substance of hard palate and aperture between oral and nasal cavities, from gunshot wound. The teeth and fragments of jaw, shown on the right, were separated from the rest of the jaw by the projectile. There is fibrous union with a faulty alignment of fragments. The dental appliance shown in the picture has been affixed for the purpose of restoring the alignment of the teeth and of diminishing the space between the teeth caused by the loss of teeth and displacement.

Fig. B. Final result in Case 1, 2 months after operation. The aperture has been entirely closed and the functional result is excellent.

Fig. C. Actual pathology in Case 2, showing loss of substance in hard palate from machine-gun bullet injury. Note also the absence of the upper right molar and bicuspid teeth, which were removed by the passage of the bullet.

Fig. D. Final result in Case 2, with complete obliteration of the aperture and excellent functional restoration.

Plate I. (*Plastic Repair of the Hard Palate for Loss of Substance from Gunshot Wound. Fred H. Albee.*)

DEPARTMENT OF TECHNIQUE

PLASTIC REPAIR OF THE HARD PALATE FOR LOSS OF SUBSTANCE FROM GUNSHOT WOUND

By Colonel FRED H. ALBEE, M.R.C., U.S.A.
Formerly Chief of Surgical Service, U. S. A. General Hospital No. 3, Colonia, N. J.

LOSS of substance of the hard palate from congenital defect or from direct trauma, is not uncommon. In military experience, cases of gunshot injury to the hard palate, involving extensive loss of substance have been frequently encountered. The attendant difficulties of mastication in such cases, with the resulting ill-effects on the health of the patient, as well as the serious interference with his comfort and well-being through the acute consciousness of the impediment to enunciation, etc., emphasize the importance of repair of such a defect.

Fig. 1. Case 1. Drawing demonstrating position of the head of the patient over the end of the operating table, with the Connell-Y tube in place at *A* (see Fig. 2). Note the accessibility afforded, the good view of operating field and the ease with which the surgeon is able to work on the roof of the mouth and the palate when the patient is placed in this position.

In an experience with a wide variety of plastic cases, both at U. S. Army General Hospital No. 3, at Colonia, N. J., and in French military hospitals during 1916, none, perhaps, have presented results more interesting and gratifying to the author than two cases of restoration of loss of substance of the hard palate, which are herewith reported. The first case illustrates the use of a pedicle flap of mucous membrane and submucous tissues, secured from the inner side of the lip, in the repair of this defect, a method, which, so far as the author is aware, has never heretofore been employed. In this case, two teeth with the alveolar process had been shot away by the same bullet that destroyed a portion of the hard palate. The extensive scar and the large size of the aperture in the hard palate, remaining after the healing of the wound, made it necessary to secure material for the repair of this defect elsewhere than from the palate, itself. Through the cleft caused by the loss of the two teeth and the complete thickness of the alveolar process, a large plastic pedicle flap was drawn from the inner side of the lip, by means of which the aperture was closed.

It is believed that the technique followed in the foregoing instance is one that may well be

Fig. 2. Case 1. Sagittal section showing interior position of Connell-Y tube with catheters 12 centimeters in length.

Fig. 3. Case 1. Diagram to demonstrate the plastic flaps *A* and *B*, before they are displaced to close the aperture.

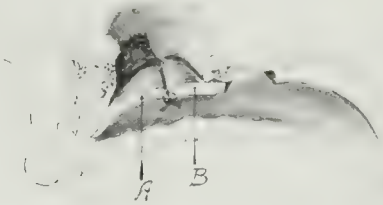


Fig. 4. Case 1. Showing the adjustment of the plastic flaps to close the aperture. Attention is directed to flap *A* which has been swung downward, hinge-like, and is now at right angles to its former position.

generalized and applied to all cases of extensive loss of substance of the hard palate, resulting from traumata, congenital defects, pathological conditions, etc., in which cases on account of lack of available tissues for the closing of large apertures, the above procedure of obtaining the plastic flap may be employed by the preliminary means of the extraction of one or two teeth and the removal of the alveolar process surrounding these teeth to a depth sufficient to permit of a cleft through which the pedicle flap may be drawn. In the case above cited it should be again emphasized that this had already been accomplished by the passage of the bullet.

In work of this nature, it is hardly necessary to call attention to the highly desirable character of the tissues comprising a pedicle flap taken from the inner side of the lip, the vascularity

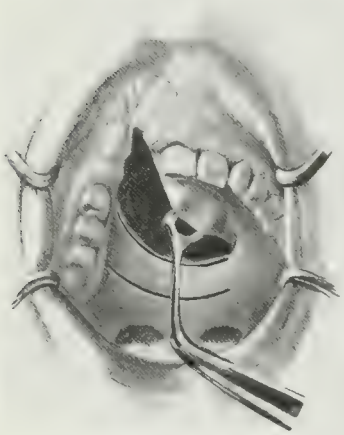


Fig. 5.

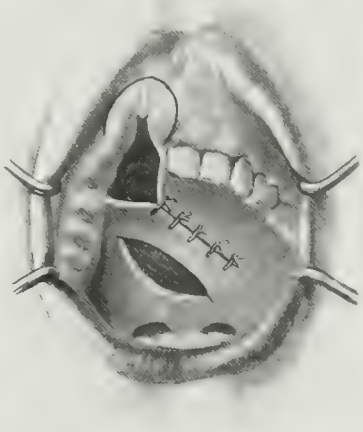


Fig. 6.

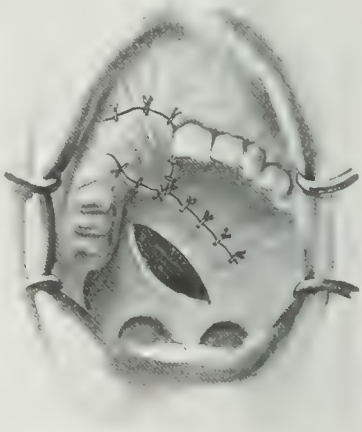


Fig. 7.

Fig. 5. Case 1. Showing the incisions made for the purpose of freshening the edges of the aperture and to form the plastic flaps. The technique of separating the flaps by means of the McBurney retractor, as described in the text is also indicated.

Fig. 6. Case 1. The aperture has been closed as far as is possible by means of the material available from the roof of the mouth. A circular incision is shown in the mucous membrane of the inner side of the lip, preliminary to the formation of a flap which is to close in the remainder of the aperture by being drawn through the cleft in the alveolar process, as described in the text.

Fig. 7. Case 1. Complete closure of the aperture, demonstrating flaps and sutures in place.

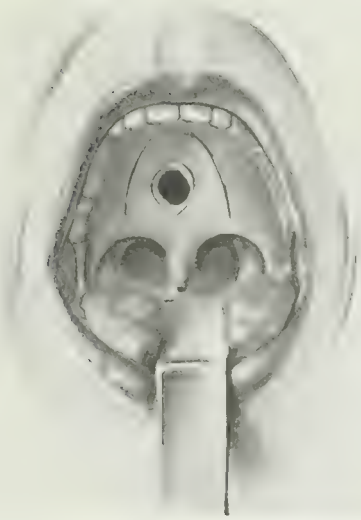


Fig. 8 (at left). Case 2. Showing the incisions made to freshen the edges of the aperture, as well as to form plastic flaps for its closure.

Fig. 9. Case 2. Showing the displacement of the flaps with the closure of the aperture and placement of the silk sutures.

of tissues of this region, or their remarkable plasticity. In all such cases, in which a large amount of scar tissue surrounds the aperture and an environment unfavorable to the growth of free transplants is presented, pedicle grafts from the lip seem definitely indicated. Moreover, where loss of substance is extensive, as in the case cited above, this technique is a necessity, since there is no other possible source of obtaining material.

On the other hand, in the second case of loss of substance of the hard palate, to be reported, the aperture resulting from the gunshot injury was not so large, nor was there so great an amount of scar tissue in the soft parts surrounding it. In this case it was possible, therefore, to secure sufficient material from the hard palate, itself, in restoring the loss of substance. Detailed reports of these cases follow:

Case 1. B. H., age 21 years, Corporal, Co. K., 9th Inf., A. E. F., was injured on July 18, 1918, at Soissons, by a machine-gun bullet which, entering the right side of the face near the nose, destroyed in its passage a large portion of the hard palate and removed two teeth on the left side of the upper jaw, together with the adjacent alveolar process, causing a complete separation of the anterior portion of the upper jaw, from the posterior portions on each side. The patient was first removed to a French field hospital, where he was operated upon the following day, and thence to various hospitals in France for treatment, returning to the United States in December, 1918.

Upon admission to U. S. Army General Hospital No. 3, Colonia, N. J., on December 9, 1918, his wounds were entirely healed, but the jaw fragments were not in alignment and there was fibrous union. His general physical condition was good, although he was slightly under normal weight. Owing to the size of the aperture in the hard palate, much difficulty was experienced in masticating food, and in swallowing. It was also impossible for the patient to enunciate clearly and on account of an inability to control under pressure the passage of air in the oral cavity, he could neither expectorate, whistle nor blow his nose.

The patient was assigned to a convalescent ward for observation and for dental treatment in preparation for the final plastic repair. For 10 weeks he was under the care of the prosthetic dentist, who by means of the apparatus shown in Plate I, Fig. A, and by other orthodentia methods, slowly drew the island of teeth and the jaw fragment into general alignment with the remaining teeth and portion of the jaw.

Operation. On June 6, 1919, the plastic closure of the aperture in the hard palate was performed. The patient was placed upon the operating table in a dorsal position, with the head hanging over the end of the table in extreme hyperextension, the long axis of the head being approximately at right angles to the trunk, as shown in Figure 1. The jaws were separated by means of a mouth-gag, whereby a good view and a comfortable approach of the operating field were secured to the operator as he sat on a stool with the top of the patient's head hanging just above his lap, as shown in Figure 1.

Induction of anæsthesia was produced by means of ethyl chloride and drop ether, and was further maintained by intra-pharyngeal insufflation of ether vaporized with oxygen through a Connell-Y tube, as illustrated in Figures 1 and 2. By the use of the Connell-Y tube, the surgical stage of the anæsthesia was evenly maintained without interfering with the operation. To prevent the flowing back of excessive blood into the trachea and pharynx, a sponge, constantly renewed as it became saturated, was kept between the posterior part of the hard palate and the base of the tongue. This sponge also served

Fig. 10 (at left). Case 2. Showing carmichaels on both central incisor teeth and a gold shell crown on molar tooth, with a gold bar connecting. This appliance was attached by C. C. Prosser, D.D.S., for the purpose of furnishing a support for the rubber restoration, shown in Figure 11.

Fig. 11. Case 2. The missing teeth have been restored by a *removable rubber restoration*, which is affixed to the gold bar, shown in Figure 10, by Gilmore attachments. This very satisfactory work was also done by C. C. Prosser, D.D.S.

to prevent the escape of the anæsthetic from the pharynx through the mouth.

Great care was first taken to freshen the edges of the aperture by removing the scar tissue well into the healthy area, as illustrated in Figure 5. One-half inch back of the posterior portion of the aperture, a parallel circular cut was made completely through to the bone of the hard palate above (as is indicated in Figure 5), producing a strip of soft tissue of the hard palate for a flap, which is shown in this same figure, and also in Figure 3, *B*. On the anterior portion of the aperture, a cut was made producing a plastic flap, as shown in Figure 3, *A*.

Both plastic flaps, *A* and *B*, were separated from their bony attachments by means of the best instrument available, namely, a McBurney goiter retractor, which is shown in Figure 5. This instrument, by nature of its hoe-like characteristics, permitted these flaps to be easily separated from the bone. These plastic flaps were then brought into apposition by interrupted sutures of No. 4 braided silk, as indicated in Figure 4, *A* and *B*, and in Figure 6.

As noted in Figure 6, it was possible to close only about one-half of the aperture; the remaining half was very readily and satisfactorily filled by a swinging flap from the inner side of the lip, as is indicated by the circular incision in the mucous membrane in Figure 6. This flap was turned and twisted on its pedicle and used to cover the remaining portion of the aperture, in the manner shown in Figure 7. Very satisfactory primary union occurred in every portion of the wound, and the silk sutures were removed on the sixth day. Convalescence was uninterrupted in every particular.

Final results. At date of writing (August 18, 1919), about two months after operation, the results have been satisfactory in all respects, as shown in Plate I, Fig. B. The patient has experienced special gratification in the restoration of his lost functions as to ease in enunciation, mastication, etc.

Case 2. E. T., age 29 years, Second Lieutenant, Co. 20, 5th Marines, A. E. F., while on duty at Château-Thierry on July 6, 1918, was struck by two machine-gun bullets: one entering just in front of the lobe of the left ear, passed forward and inward, becoming imbedded in the antrum of the right superior maxillary bone; the second bullet, entering the mouth, removed the bicuspid and molar teeth from the right upper jaw and made its exit just below the antrum. The patient was treated at various hospitals in France, returning to America in September, 1918.

Upon admission to U. S. A. General Hospital No. 3, Colonia, N. J., on September 9, 1918, his general condition was excellent. Examination of his war injuries showed fibrous ankylosis of the temporomandibular joint on the left side, as a result of the injury, and destruction of a portion of the hard palate and the temporal bone near the glenoid fossa. There was an aperture of $\frac{5}{8}$x$\frac{7}{8}$ inches in diameter, in the hard palate, extending completely through from the oral cavity to the nares, as shown in Plate I, Fig. C.

The patient received treatment for necrosis of the right antrum of the superior maxilla, portions of necrotic bone being removed from the vomer and the hard palate. On November 15, under anæsthesia, roots of two teeth, upper molars, were removed, the alveolar process was curetted, and the fibrous ankylosed joint was stretched by forcing the jaws apart manually, and by means of a conical-shaped screw of hard rubber, known as the *rubber screw oral gag*, commonly used by the anæsthetist. The patient was instructed to use this screw himself daily. He was also given physio-therapeutic treatment, consisting of daily massage and forcible manual opening of the jaws.

Operation. On March 26, 1919, eight months after being injured, and about two months after healing of the wounds, operation for the plastic closure of the aperture in the hard palate was performed. The mode of anæsthesia in this case was the same as employed in Case 1.

With the patient in a similar position to that assumed in Case 1 (see Figures 1 and 2), the edges of the aperture were well trimmed and denuded of scar, as illustrated in Figure 8. Incisions about one-half inch laterally to the aperture, on either side, as shown in Figure 8, were made with a small scalpel completely through to the bone beneath, thus mapping out two plastic flaps, each having two

pedicles, anteriorly and posteriorly. With an appropriate blunt dissector, these flaps were separated from their bony attachments to such an extent that they might be approximated to the center. Internal sutures of silk were then inserted and the aperture was closed in the manner indicated in Figure 9. The wound healed by primary union, all stitches holding. The sutures were removed 6 days after the operation.

Final results. The repair in this case has been perfect, both anatomically and functionally, Plate I, Fig. D. Notwithstanding the fact that the patient was referred to U. S. Army General Hospital No. 3, Colonia, N. J., for arthroplasty of the temporomandibular joint, free motion of the jaw and normal function have resulted. Three months after operation, the patient was discharged, and returned to his home to resume his former occupation.

EPIDIDYMECTOMY, AN IMPROVED TECHNIQUE

By MAXIMILIAN STERN, M.D., New York

IN cases of tuberculosis involving the epididymis, its removal before extension to the gonad has occurred is imperative. The accomplishment of this simple operation is complicated by the possibility of injury to the blood supply of the gonad, which would either impair or eliminate its endocrine value. Stress is laid upon this element in the literature on epididymectomy, but no definite description is to be found whereby this can be avoided. Though the other organ might supply sufficient internal secretion, its future involvement is a frequent occurrence, and the preservation of all gonad tissue is advisable. The illustrations amply describe the operation in detail.

When the removal of a greater length of the vas is indicated Cabot's operation for epididymovasectomy through an additional incision over the internal ring is required. It is then only necessary to free the vas by blunt dissection in the inguinal canal and pull the cut end up and out. Ligating it at the internal ring will in all probability eliminate a tubercular focus beginning in the epididymis. A vas showing disease at this level of the internal ring would be indicative of seminal vesical infection requiring a more elaborate surgical procedure.

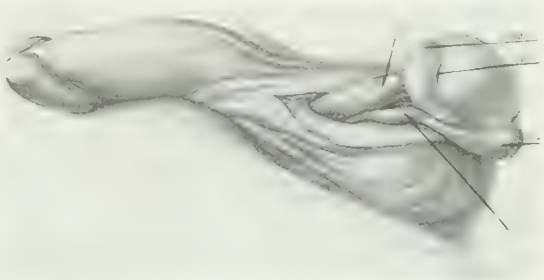


Fig. 1. Vascular pedicle, *v. p.*, is seen in front of vas. Separation exaggerated. Vas is seen to descend to lower pole of gonad, where it swells out (globus minor, *G. min.*) and turns upon itself to terminate at globus major, *G. M.* It lies in front of the vascular pedicle and shows a semilunar fold *S. L. F.*, under which scissors can be inserted, in separating the globus major from the vascular pedicle.

Fig. 2.

Fig. 2. Points of scissors emerging between globus major and vascular pedicle.

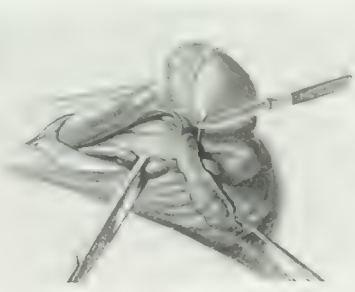


Fig. 3.

Fig. 3. Globus major separated from vascular pedicle. Reflection at globus minor seen.

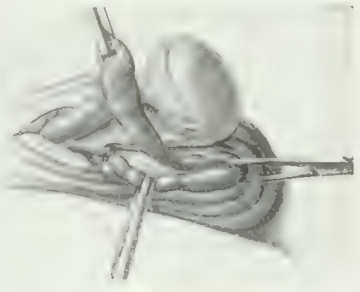


Fig. 4.

Fig. 4. Epididymis freed and ligated.

PROSTATIC-AMBULANT POSTOPERATIVE MANAGEMENT

By A. E. ROCKEY, M.D., F.A.C.S., Portland, Oregon

THE ambulant postoperative management of prostatics is an evolutionary sequence of a simplified operative technique that we have employed for more than ten years. This feature of the plan has been developed by permitting the more favorable cases to move about as they desired, and then seeing the definite advantage to their general well-being, of encouraging the feeble or indifferent to an earlier activity than has been usual. This method of treatment is generally applicable to what might be considered fairly normal cases. The neglected and nearly moribund that require the preliminary drainage of a two-stage operation are, however, not infrequently benefited by a short ambulant period before the gland is enucleated. Such treatment is favorable only when a very small amount of tissue trauma has been caused by the operation.

Prolonged operations do not tend to quick recovery. There has been no change in the technique which I described in Surgery, Gynecology and Obstetrics in February, 1913. The chief features are the short suprapubic incision and finger enucleation of the gland; delivery with fenestrated forceps; suspension of the bladder in the space of Retzius by a single catgut suture on each side of the incision; the insertion of a small drainage tube; and most important of all the total abandonment of irrigation.

Postoperative irrigation is a surgical error. It promotes the continuance of bleeding, devitalizes the freshly exposed tissues, and favors the formation of sloughs by removing the blood clot which is the natural hæmostatic and protective of the wound.[1]

A week or ten days postoperative, when the drainage tube is removed, we commonly irrigate once through a rather large soft urethral catheter to wash out any gross detritus that may remain at the bottom of the bladder. At this time one may introduce a cystoscope through the suprapubic wound, and while the water is flowing inspect the healing prostatic cavity. In this way we may easily gain interesting and useful information of the method and progress of recovery. Even when a large gland has been removed, the cavity is reduced to a small cone lined with new granulation tissue. The urethral mucosa is seen at the bottom, and the irregular edge of the bladder margin at the top. Across this zone, healing rapidly advances without irrigation. In a few cases it may be well if the suprapubic opening is slow in closing to safeguard a sufficient patency of the neck of the bladder by the gentle passing of a sound.

The dressing is a simple pad of absorbent cotton, or cellulo-absorbent, covered with a

[1]Rockey. Prostatectomy without irrigation. Boston M. & S. J., 1914 March 12.

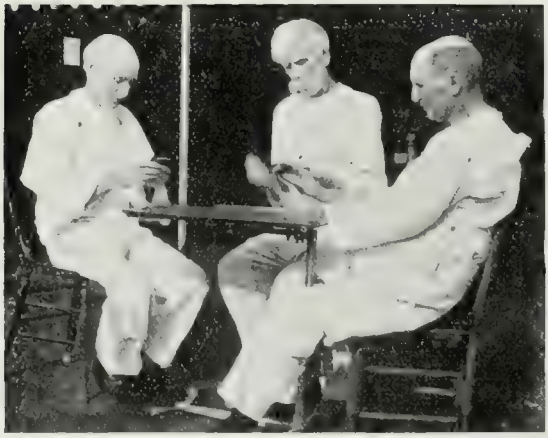


Fig. 1. Postoperative prostatics at a friendly game on the roof garden at the Good Samaritan Hospital. Their ages from left to right are 74, 71, and 63.

Fig. 2. Postoperative prostatics dressed in painter's overalls, promenading on the roof garden. Their ages from left to right are 83, 78, and 77.

single layer of gauze. The pads are retained with adhesive tie tapes. Over this the ambulant patient wears painter's overalls, of which two or three pairs should be provided.

The patient may be permitted or encouraged to physical effort only as his condition permits. Our usual plan is to have him sit up in bed on the second day, to get up in a wheel chair on the third, and walk about as he pleases on the fourth. He enjoys a game of cards, promenade, or the gossip of the smoking room better than an irksome confinement in bed. The problem of nursing care is much simplified. Figures 1 and 2 illustrate the ambulant plan. Continued experience has demonstrated marked improvement in appetite, sleep, general comfort, and contentment, and a definite shortening of the postoperative period.

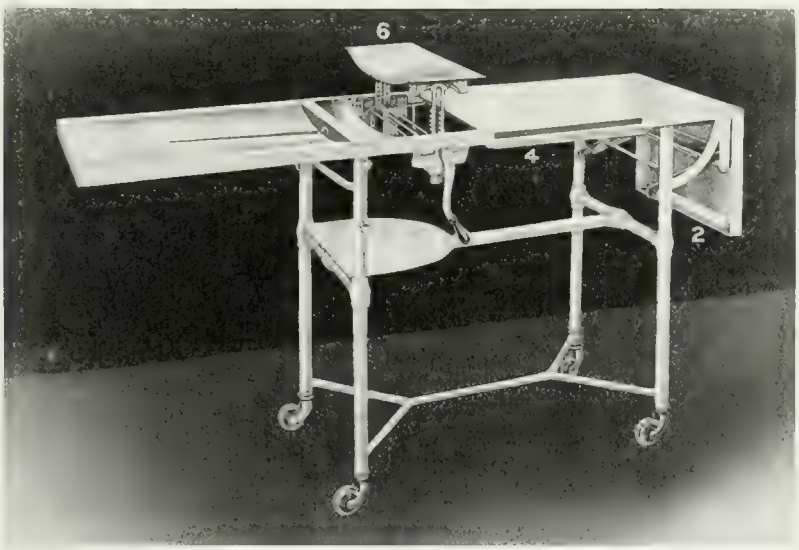
A NEW CYSTOSCOPIC TABLE

By HERMAN L. KRETSCHMER, M.D., F.A.C.S., Chicago
Urologist, Presbyterian Hospital; Genito-Urinary Surgeon, Alexian Brothers Hospital

NEARLY all genito-urinary surgeons use the lithotomy or modified lithotomy position in performing cystoscopic examinations and a great many cystoscopic tables have been devised in order to obtain the desired position. This position necessitates the patient's being placed so that the buttocks rest at the edge of the table, the body being more or less semi-erect, and the legs raised upward, being supported at the knees by knee-rests. This position, to say the least, is very uncomfortable and one that is difficult for some patients to assume, especially those suffering from arthritis or ankylosis of one of the joints of the lower extremity. When patients are in this position for a long time, it is very uncomfortable and occasionally produces more or less distress.

It has always seemed to me that the prone position is a more comfortable one as well as a more natural one for the patient to assume and one that can be obtained in an emergency, on any sort of a table.

Nothing new is claimed for cystoscoping patients in the prone position. To render this position more convenient for routine work the cystoscopic table about to be described was designed.



A new cystoscopic table. *2*, Head rest; *4*, insert for plate holder; *6*, elevator for elevating pelvis.

In its construction it was designed primarily for routine cystoscopic examinations, ureteral catheterizations, various intravesical manipulations, such as fulguration or litholapaxy, as well as for routine irrigations and postoperative dressings.

The standard cystoscopic tables do not sufficiently provide against the soiling of the floor with the wash water that is used for irrigation. Consequently the floor cannot be kept dry and this often aids in producing short circuits. This annoyance has been completely eliminated in our work with this table.

The table was built of a height that would make its use convenient. An elevator is attached for raising the pelvis, which is accomplished by means of a crank attached at the side of the table.

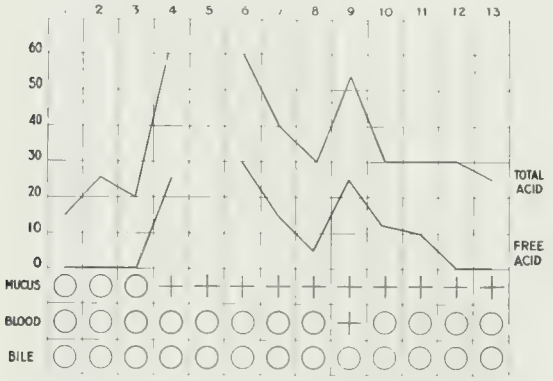
In order that the table may also be used for taking pyelograms without moving the patient from the table, an aluminum insert has been attached, so that a plate-holder may be slipped under the table without disturbing the patient's position. When the table is in use the head-rest is down. The head-rest is used only when pyelograms are to be made.

THE RAMMSTEDT OPERATION IN ADULTS

By HENRY F. GRAHAM, M.D., F.A.C.S., Brooklyn
Assistant Surgeon, Methodist Hospital, and Associate Surgeon, The Norwegian Hospital

THE Rammstedt operation is now generally accepted as the best procedure for nearly every case of infantile pyloric obstruction. It is not so well known, however, that this operation occasionally may be of great value in curing adults who are suffering from pylorospasm and are incapacitated thereby. The following case is reported to illustrate this fact.

S. M., age 46, Italian, married, longshoreman. This patient has suffered from pain in the epigastrium for the past 12 years. It has been worse for the last 2 years. The bowels are costive. He has to take cathartics once or twice a week or he becomes very uncomfortable. His weight is now 146 pounds whereas it formerly was 175 pounds. He has frequently been nauseated and has vomited. He cannot eat meats or acids. He improves for a few months and then becomes worse again. Five years ago he contracted malaria in South Africa. This lasted two years and since then the stomach symptoms have gradually become worse. The pain is worse at night. There is often much distress from gas. The past history is irrelevant. He has never had a chancre.



Rehfuss fractional test.

Physical examination. The man is of medium frame, fairly well nourished. His color is good although like most Italians he is a little sallow. The pupils react to light and accommodation. The teeth are discolored but there is no pyorrhœa. The heart and lungs are normal. The abdomen is scaphoid, with no tenderness, masses or rigidity. Murphy's sign is not present. Reflexes are normal.

The patient entered the Methodist Hospital, January 20, 1919. Blood urea 28.7 milligrams. Wasserman, 1+. The Wassermann was later reported negative by the department of health laboratory. No antisyphilitic treatment had been administered in the interval. The urine was normal. For the Rehfuss fractional test see diagram.

Operation January 23, 1919. Upper right rectus incision. The pylorus was found thickened and cartilaginous with the lumen almost obliterated. The gall bladder, stomach, and duodenum were normal. The appendix was bound down by adhesions and was the seat of an obliterating inflammation. It was removed. There were adhesions also along the ascending colon and terminal ileum.

Dr. Langworthy, who was assisting at the operation, inquired if the Rammstedt operation was ever used in adults. Of course, we were familiar with the Finney and other pyloroplasties, but I could not remember having seen any reports of the use of the Rammstedt operation in such cases. However, this particular case seemed to demand just that particular operation. The pylorus was therefore split down to the mucosa by an incision parallel to the axis of the lumen and about 1 inch in length. The mucosa was then separated from the muscle on the sides for a short distance.

The incision seemed to be slightly longer than was necessary, so a stitch was placed above and below, partially suturing it in the opposite direction from the normal. A small plug of fat was inserted between the muscle ends filling the remaining hole. This plug was held in place by a catgut stitch. These slight modifications we consider unessential. The adhesions along the cæcum and ascending colon were released. The abdominal wall was closed by layer suture. Time consumed by operation 35 minutes.

March 6, 1919. The patient has gained 3 pounds in 14 days. He has suffered from none of the old pain since operation. On June 5, 1919, the patient weighed 146½ pounds. He has had influenza and has lost 5 pounds. On

July 30, 1919, he weighed 150 pounds. "Feel very fine." He eats anything and is at work again as a longshoreman.

December 28, 1919. Patient still remains well.

It might be argued that the pylorospasm in this case was caused by the chronically inflamed appendix and was cured by the appendectomy. I can only say in reply that in my opinion the cessation of pain was too prompt and too permanent to have been caused solely by removal of the appendix. In similar cases I have seen, no such relief was obtained when nothing more than an appendectomy was done.

THE USE OF INTRAMEDULLARY AND EXTRACORTICAL BEEF BONE SPLINTS IN THE REPAIR OF FRACTURES OF LONG BONES

By ADDISON G. BRENIZER, M.D., Charlotte, North Carolina

THE purpose of this paper is not to make a comparison between autogenous, homogeneous and heterogeneous bone grafts. I agree, without discussion, that the autogenous graft, including periosteum, cortex and marrow, taken as one would a slice from a water melon, from another bone of the same individual, is superior in every respect, so far as the grafting material is concerned.

Where there is considerable breech to span, in long bones or between the spinous processes of the spine or in defects of the skull, I should never recommend a heterogeneous graft, but would always use an autogenous graft or, more

Fig. 1.

Fig. 2.

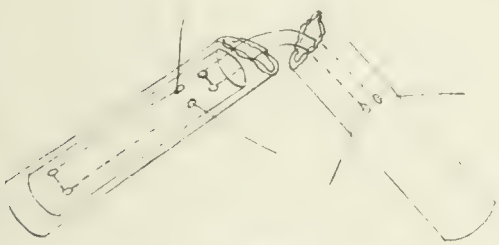


Fig. 3.

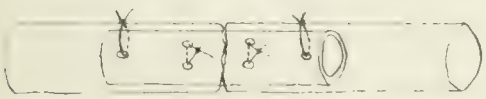


Fig. 4.

Fig. 1. Perforated bone cylinder.

Fig. 2. The cylinder threaded with two sutures of kangaroo tendon.

Fig. 3. The cylinder in place in the medullary cavity of one end of the bone to be splinted. The ends of the suture are seen threaded through two drill holes in each bone end. This drawing demonstrates how the intramedullary cylinder can be pulled across the breech in the bone and from one bone end to the other by drawing on the sutures.

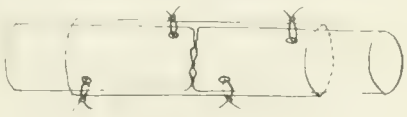


Fig. 5

Fig. 6.

Fig. 7.

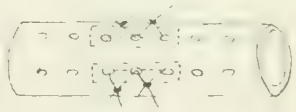


Fig. 8.

Fig. 4. The cylinder is drawn across the breech into both bone ends and tied in place.

Fig. 5. The application of the extracortical cylinder.

Fig. 6. The application of a part of the circumference of the extracortical cylinder, as a substitute for bone plates, when the bone through callus, scar, etc., is difficult to surround.

Fig. 7. The intramedullary cylinder is armed with four small strips of periosteum and underlying bone, tied to the outside of the cylinder, to be drawn into position across the breech in the bone. The periosteal surface is turned toward the cylinder.

Fig. 8. Shows the same sort of small bone strips, tied to the inner side of the extracortical cylinder, with the periosteal surface against the cylinder.

rarely, a homogeneous graft, from another individual of the same blood group as the one to be grafted.

I do not use the term "beef bone grafts" but rather "beef bone splints," for they are splints, as they are boiled and kept in alcohol until every organic, living cell is dead.

These bone splints are frequently more adaptable, than the sliding graft and often more adaptable than the transplanted autogenous graft. After serving their purpose as splints and as a scaffolding for new formed bone, they are finally absorbed, but they have served their purpose nevertheless.

These bone splints can be used as well as conveyors of small autogenous grafts, where the support and strain falls upon the bone splints, and the bone regeneration upon the small autogenous grafts. This combination of intramedullary and extracortical bone splints and autogenous bone grafts will be described directly.

Two of my patients, I remember well, when I was asking for the privilege of using a graft from the tibia for the radius and ulna, in case I could not make a satisfactory sliding graft, remarked: "My leg is all right now, why trouble it for the arm!" It is sometimes difficult to explain to patients, though it is true, that new bone soon fills the tibia in and the leg becomes strong.

Employing the Albee and Geiger bone sets with their attachments, cylinders of bone taken from the various long bones of older calves and cows, are easily fashioned and can just as easily be adapted at the time of operation. The beef bone cylinders are simply boiled twice for a half hour in 2 per cent sodium solution and kept in alcohol. Before use, they are soaked in sterile salt solution.

LARGE AND SMALL DOSES OF RADIUM

By C. W. HANFORD, M.D., Chicago

THE writer has often stated, and other observers in the field of radium therapeutics have voiced the same thought, that radium is of distinct value in cases of inoperable cancer, particularly of the cervix uteri. And yet recent experiences have shown that some surgeons (?) either do not know when a case is inoperable or use the knife, regardless of consequences. I consider that this attitude is as open to criticism as that of employing escharotics and other agents, after it has been plainly demonstrated that a patient has cancer.

If the surgeon is so anxious to use the knife in a case of cancer of the cervix uteri when possibly the vaginal wall is involved, he should have enough regard for the patient to employ radium in the cervix and vagina until the local lesion is cleared up, at which time the chances for good end-results have increased many times. The time has passed when there is any guess work as to the action of radium rays in malignancy.

Given a case of carcinoma of the cervix, if the patient is not too much weakened by the disease, we can almost promise a clearing up of the local lesion, with the unpleasant accompanying conditions—bleeding, odor and pain—after administering a dosage of 4,000 to 5,000 milligram or millicurie hours.

I am sure that all who have followed radium therapy closely are of the opinion that when the diagnosis of cancer has once been established, it is absurd to temporize with small doses and short applications of radium. It is vitally imperative to strike hard when using radium in malignancy.

If we have a case of cancer of the tonsils, we should not think of giving less than 1,200 to 1,500 milligram hours; and this should be given in a period of two days at least, better at one session. This means if we are using a 50 milligram tube, it is to remain *in situ* at least 24 hours. And again, the tube or needle should not be merely placed against the growth; it should be sunk into the center of the growth and fastened there.

Wherever the dosage and time referred to above is used, there is naturally a slough of tissue in the immediate vicinity of the radium. This commences in about a week or ten days after the treatment, but as the walls of arteries and veins are very resistant to the rays of radium, danger from hæmorrhage, due to the penetration of the walls of vessels, need not concern us.

An illustration of the value of striking hard with radium after the diagnosis of cancer is confirmed by microscopical section, the following case will serve.

The patient, age 47, a farmer from Janesville, Wisconsin, was referred to the writer by T. B. Wiggin, of Chicago. He gave a history of tonsillar affection that commenced 6 months ago. The soft palate became invaded, until finally the existing hole would easily receive an English walnut. This cavity extended back and up some distance. Besides this, one of the cervical glands on the right side of the neck just under the ear was as large as a hen's egg. The patient was totally deaf in the right ear. He had lost 40 pounds in weight and was very weak.

One hundred and eighty milligrams of radium screened to exclude the β-rays were placed in the cavity in the soft palate and stitched in. The radium was left in place for 9 hours. No treatment was given the next day, but the day following, the patient received the same dose for 5 hours. Again a day was allowed to elapse and the day after, the treatment lasted 6 hours, making a total of 20 hours, or 3,600 milligram hours, over a period of 5 days.

The patient went home, returning to the hospital after 12 days. The cavity in the soft palate had markedly narrowed, there was no odor, and even after examination, there was no bleeding. The gland on the side of the neck had diminished one-half. At the first examination, an enlarged gland in the submaxillary region was found; this had entirely disappeared. The patient felt much stronger and more hopeful. He was now given one application in the cavity of 110 milligrams for a period of 6 hours. Also James N. Neff ligated the external carotid, even though improvement had been so marked after the first treatments.

The patient returned home and did not come back to the hospital for a month. He had gained 25 pounds in weight. The hole in the soft palate had nearly closed. There was no sign of the large gland. The patient said he had been doing all of his farm work and never felt better in his life.

Prior to receiving radium treatment he had sought aid at the largest medical and surgical institution in the North West, but was given no satisfaction. A recent letter states that he is nearly back to his normal weight.

Now if temporizing methods had been employed in this case by using 25 or 50 milligrams of radium, the final good result would have been very slow in coming, and I am very doubtful if a definite result would have ever been gained.

MASSIVE DOSES

The writer believes that if he were in possession of 2 or 3 grams of radium, as is the case at a few eastern institutions, he would always speak of massive doses for short periods, for there is no doubt that there is considerable satisfaction in having at hand this large amount of an ultra expensive element. But from a therapeutic standpoint, the application of anything over 200 milligrams of radium element to any one point, is simply for the purpose of shortening the hours of exposure. If we wished to give a uterine fibroid a 1,500 milligram hour irradiation, we would use 100 milligrams of radium for 15 hours. Or if we possessed 500 milligrams in one tube or 500 millicuries (emanation) in a needle, it would be in position but 3 hours.

The writer will concede this point: that in deep malignancy the employment of any dose less than 50 milligrams for a series of hours, is often harmful, in that there is not enough power in the γ-ray content to act as a lethal agent against cancer cells. But, on the other hand, in a zone slightly removed from a small dose of radium, the cancer cells will be whipped into activity, and we have as a result a more grave condition to deal with than if nothing had been used.

The fact that the use of radium in suitable cases does not entail a great loss of tissue commends its use in cases where the radical use of the knife would cause great disfigurement.

The writer's position as regards cancer of the breast is, he believes, held by all who have had more than a passing acquaintance with radium. The surgeon should always have first chance in these cases, but I still believe that the prophylactic treatment with radium at the time of the operation or within a few days after should not be overlooked.

It is natural that only by experience and close observation, can the best results be obtained from so powerful an agent as radium. Because of its innocent appearance, and until recently, lack of information as to dosage, etc., many have been led to believe that they can place the tube anywhere, for indeterminate hours with no fear of untoward results. They are surprised, when the reaction sets in in a week or ten days after treatment, to note an ever increasing area of redness and final destruction of tissue, when the proper application should have produced no more perhaps than a redness. Therefore, I am sure that all radium therapeutists will agree with the writer that each case should be viewed by one thoroughly acquainted with the action of the rays of radium. We have all seen the havoc wrought in the vagina by the too long application of radium and improper screening, thereby causing rectovaginal and vesicovaginal fistulæ.

In treating new-growths with radium, there are some things we cannot expect to accomplish. These include—

Very little benefit in cancer of the tongue, if the glands of the neck and submaxillary region show involvement.

Only temporary improvement in carcinoma of the rectum, especially if of the hard non-vascular type. In some instances the vascular type, if in the middle and upper third, respond fairly well.

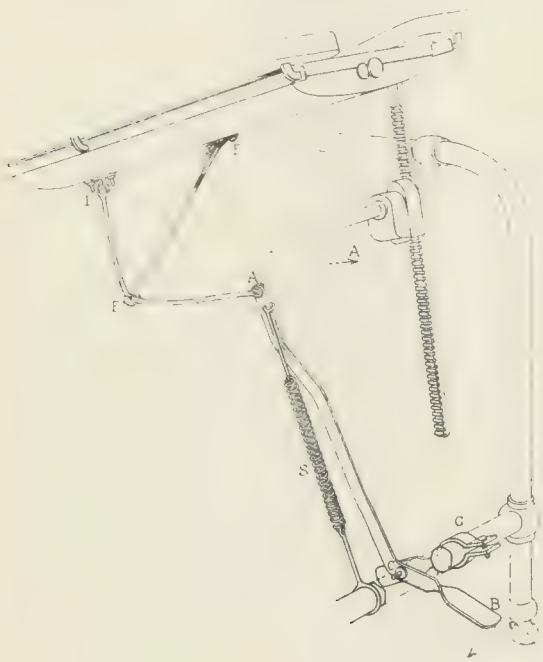
Recurrent cancer of the breast if submitted to radium treatment some months after the operation, show little if any improvement, because the invasion of the lymphatic system is extensive. The time to use radium in breast cancer is immediately after the operation.

PRESENTATION OF A NEW PAN DEVICE ON A CYSTOSCOPIC TABLE[1]

By CHARLES S. LEVY, M.D., Baltimore

PROVISION for drainage of the irrigating fluid used in cystoscopy entails the pulling out of the pan underneath the cystoscopic table. Sterile technique during cystoscopic examination can be maintained by the operator only by having an assistant pull out the drainage pan for him. A device is described here by which the operator himself can bring the pan forward and push it back with his foot.

The apparatus consists of a clamp *G*, a series of levers and a spring *S*. The illustration shows the attachment of these mechanical devices to the lower portion of a Young cystoscopic table The apparatus is so constructed that it is easily attached to any table on the market. It is inexpensive and out of the way.



Pan device for cystoscopic table.

The clamp *G* is attached to the lower leg support of the table, which is usually at the height of 6 to 8 inches from the floor, either in the center or, better still, to the right of the mid line. A lever *A-B* is fastened to the clamp with a fulcrum at *C*, a point behind the bar, and then brought to the center, by bending if necessary. *B* acts as a foot lever, *D* represents the end of the pan, and *F* a point anterior to its center. The rods *D-E* and *F-E* join at *E*, a movable joint. *E-A* is a connecting rod between the main lever, *A-C-B*, and the pan, and the union at *A* may be either a sliding slot or a bolt-screw arrangement, as shown in the diagram. Pressure on the foot-lever *B* tends to bring point *A* forward toward A^1 and of course to bring the pan outward, the extent forward being regulated by the amount of pressure applied by the operator's foot. The device *D-E-A-C-B* will move the pan only in a horizontal plane, but the rod *E-F* is attached to advance the pan upward and forward at the variable heights to which the table is often raised. The spring *S* serves two purposes: in the first place, with the pan back, it has a downward and forward pull, a condition that materially aids in bringing the pan forward; in the next place, as the pan is pulled outward, the spring gradually assumes a downward pull in a vertical direction, a position which tends to lock the pan in place and to prevent it from sliding back when the operator's foot is removed. The pan is made to go back to its original position by elevating the foot-lever with the tip of the shoe.

Such an apparatus is now attached to one of the cystoscopic tables at the Brady Urological Institute and works satisfactorily.

[1] From the James Buchanan Brady Urological Institute, Johns Hopkins Hospital

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS IN SURGERY

DOCTOR GABRIEL BIDOU'S book reveals a new and personal method of *recuperation for invalids*. He calls it, "Instrumental Orthopedics," and defines it as follows: Instrumental orthopedics is the art of adapting the use of certain appliances to cripples, to replace the action of natural levers of the human body.

He believes that any alteration of the human statics affecting the normal equilibrium, closely involves the co-operation of the other levers of the human body. For example, if a cripple can normally move any portion of his body spontaneously, he will be able, with the aid of certain special appliances, to convert his movement into other movements which are lacking. To illustrate: it means that a paralytic, still possessing free movements of his shoulders will be able to make use of the lateral and lifting movements of his shoulders in such a manner as to transform such into movements of locomotion.

After having given the definition and principle of this new method, Doctor Bidou, in the first part of his book, points out how one would have to proceed to obtain the moral, somatical, and clinical acquirements of the patient, who is to be supplied with an orthopedic instrument. In his work we are witness to the whole evolution of that long observance and of all the scientific researches which will make the diagnosis of the invalid. Later in the book, the author describes the process of turning to account his special instrumentation. He deals with the multiplication and demultiplication of the human efforts, the choice of the levers, the muffling of the tractions. He indicates the various fitting of the artificial limb system which would have to be used, and he recalls several important notions of the physiology of movement.

Finally Doctor Bidou deals with the appreciable services which instrumental orthopedics can render the patient who has suffered an amputation, concerning the wearing of artificial limbs, which are often so difficult to wear because of the poor fitting of the support.

This work, condensed in 132 pages, is the result of considerable research and long experience. The book contains 20 illustrations and photographs of patients supplied with instruments made according to the rules of instrumental orthopedics.

PHILIP LEWIN.

INSTRUMENTAL ORTHOPEDICS. By Doctor Gabriel Bidou. Paris: The Orphan Apprentice School, 1919.

IT is always a pleasure to receive the Collective Papers of the Mayo Clinic.[1] Even though many of these papers have appeared in the prominent surgical journals, nevertheless to read them over again bound in an attractive volume, seems to add to the benefit already derived. Again, many of the articles appeared in journals which are not generally read by the profession at large, and these carry interest which is more than commonplace, since they are the results of investigation by observers and workers of no mean ability after prolonged and intensive study of the subject in question.

This volume includes papers prepared during the year 1918, many appearing in journals in 1919, as late as June. It is of interest to note that the list of contributors numbers forty-six, and the subject matter covers a most varied field of investigation. Aside from the ever interesting contributions on purely surgical topics by William Mayo, Charles Mayo, Judd, Balfour, Sistrunk, Masson, and others, there appears a number of most unusual papers on subjects which are more or less in the field of experimental research. The work of Luden, on "Studies on Cholesterol," Kendall on the "Thyroid Hormones," and Mann on "Experimental Study of Shock," show an immense amount of work, close observation to detail, sound judgment, and mature deductions. The masterly articles of Stokes on the "Cutaneous Aspect of Tuberculosis" deserve especial mention. He calls attention to the close association of certain skin lesions to tuberculosis, which, so far as the reviewer is aware, is entirely new and warrants consideration not only in diagnosis but in treatment.

It is, indeed, difficult to pass over any paper without saying something, as in each there is a breath of life and hope for the sufferer, a something which extends a helping hand in bridging a dangerous and turbid stream. JOHN A. WOLFER.

DURING the recent years we have heard much of plastic surgery. Many surgeons are doing so-called plastic surgery and unfortunately many failures result. The reason is possibly twofold: first, a man must have had special training in this technical branch of surgery; and, second, he must have, one might call it, preternatural ability for

[1] COLLECTED PAPERS OF THE MAYO CLINIC ROCHESTER MINNESOTA. Edited by Mrs. M. H. Mellish. Vol. x, 1918. Philadelphia and London: W. B. Saunders Company. 1919.

PLASTIC SURGERY. ITS PRINCIPLES AND PRACTICE. By John Staige Davis, Ph. B., M. D., F.A.C.S. Philadelphia: P. Blakiston's Son & Co., 1919.

this kind of work. To visualize and devise methods in plastic work is not merely a matter of training and the doing of so much routine operating. There lies behind all a certain adroitness, a dexterity, combined with vision. On the technical side, very little new has been brought forth in recent years. What appears new is mostly a new application of some time-honored procedure. This ability to apply a certain procedure to cope with a condition successfully, is the essential of a plastic surgeon. One cannot overcome this conviction in reading the recent excellent work on this subject. The author who possesses the fortunate combination of training and plastic vision, has given the profession a valuable contribution. It is the reviewer's belief that the study of this work on plastic surgery by a surgeon will not of necessity make him a plastic surgeon, but may perchance prevent many surgeons from doing plastic surgery; it may be the means of developing, in an individual who has the inherent and artistic knack for this type of work, the ability to do plastic work. There is no question but what every surgeon must utilize plastic methods of some description in his operative work and to improve this technique, it is to every surgeon's advantage to seek counsel with the plastic surgeon.

The author after a historical review and a discussion of general considerations, describes the various methods of transplantation of skin and other tissues. A chapter is devoted to the treatment of wounds, since proper wound treatment might be called the prophylactic phase of plastic surgery. In successive chapters the principle of transplantation is applied to various conditions including malformation, such as harelip, cleft palate, exstrophy of the bladder, epispadias, hypospadias, atresia of vagina, and the like. Most of the text is devoted to work about the face, as here the demand for plastic surgery is the greatest, either in the treatment of acquired or congenital defects. A complete bibliography is given at the close of each chapter.

The work as it stands today is the most complete of any on the subject of plastic surgery, and justly deserves close study. Many of the principles outlined can be used daily in routine operative work, to make general surgery neater and less mutilating. For the plastic surgeon it is his handbook and counsel. JOHN A. WOLFER.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE OPERATIVE STORY OF GOITER; THE AUTHOR'S OPERATION. By William S. Halsted, M.D. Baltimore: Johns Hopkins Press, 1919.

A MANUAL OF OBSTETRICS. By Edward P. Davis, A.M., M.D., F.A.C.S. 2d ed. revised. Philadelphia and London: W. B. Saunders Company, 1919.

A MANUAL OF OBSTETRICS. By John Cooke Hirst, M.D. Philadelphia and London: W. B. Saunders Company, 1919.

ATLAS OF OPERATIVE GYNECOLOGY. By Barton Cooke Hirst, M.D. Philadelphia and London: J. B. Lippincott Company, 1919.

THE PREVENTION OF DENTAL CARIES AND ORAL SEPSIS. By H. P. Pickerill, M.D., Ch.B.M.D.S. (Birm.), L.D.S. (Eng.). New York: Paul B. Hoeber, 1919.

THE PRACTICAL MEDICINE SERIES. Vol. ii, General Surgery, edited by Albert J. Ochsner, M.D., F.R.M.S., LL.D., F.A.C.S. Chicago: The Year Book Publishers, 1919.

A TEXTBOOK OF UROLOGY IN MEN, WOMEN AND CHILDREN, INCLUDING URINARY AND SEXUAL INFECTIONS, URETHROSCOPY AND CYSTOSCOPY. By Victor Cox Pedersen, A.M., M.D., F.A.C.S. Philadelphia and New York: Lea & Febiger, 1919.

ROENTGEN INTERPRETATION; A MANUAL FOR STUDENTS AND PRACTITIONERS. By George W. Holmes, M.D., and Howard E. Ruggles, M.D. Philadelphia and New York: Lea & Febiger, 1919.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY. A new and complete dictionary of the terms used in medicine, surgery, dentistry, pharmacy, chemistry, nursing, veterinary science, biology, medical biography, etc., with pronunciation, derivation, and definition. By W. A. Newman Dorland, A.M., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1919.

A REPORT OF THE SCIENTIFIC WORK OF THE SURGICAL STAFF OF THE WOMAN'S HOSPITAL IN THE STATE OF NEW YORK, 1919.

DIE INDIKATIONEN ZUR KUENSTLICHEN UNTERBRECHUNG DER SCHWANGERSCHAFT. By Prof. Dr. G. Winter. Berlin and Vienna: Urban & Schwarzenberg, 1918.

DIE ERHALTUNG DES KINDESLEBENS IN DER GEBURT. By Prof. Dr. Walther Benthin. Berlin and Vienna: Urban & Schwarzenberg, 1919.

THE EXACT DIAGNOSIS OF LATENT CANCER. By O. C. Gruner, M.D. Philadelphia: P. Blakiston's Son & Co., 1919.

INGUINAL HERNIA; THE IMPERFECTLY DESCENDED TESTICLE AND VARICOCELE. By Philip Turner, M.S., F.R.C.S. London: J. & A. Churchill; Philadelphia: P. Blakiston's Son & Co., 1919.

LES LÉSIONS DES NERFS. TRAITEMENT ET RESTAURATION. Paris: Masson & Co., 1919.

ANESTHÉSIE À LA STOVAINE EN CHIRURGIE ET EN MÉDICINE VÉTÉRINAIRE. ANESTHÉSIE RÉGIONALE; ANESTHÉSIE LOCALE. Paris: Masson & Co., 1919.

THE SURGERY OF EGYPT. By Frank Cole Madden, O.B.E., M.D. (Melb.), F.R.C.S. (Eng.). Cairo: The Nile Mission Press, 1919.

THE PRINCIPLES OF NURSING. By Charlotte A. Brown, R. N. Philadelphia and New York: Lea & Febiger, 1919.

OXFORD LOOSE-LEAF SURGERY. By various authors. Edited by F. F. Burghard, M.S. (Lond.), F.R.C.S. (Eng.), Colonel, A.M.S.; and Allen B. Kanavel, A.B., M.D., F.A.C.S., Colonel, M.C., U.S.A. Vols. ii to v. New York: Oxford University Press, 1919.

DIE OERTLICHE BETAEUBUNG, IHRE WISSENSCHAFTLICHEN GRUNDLAGEN UND PRAKTISCHE ANWENDUNG. By Prof. Dr. Heinrich Braun. Leipzig: Johann Ambrosius Barth, 1919.

INDEX-CATALOGUE OF THE LIBRARY OF THE SURGEON GENERAL'S OFFICE. Authors and Subjects. 3d Series. Vol. i, A-Army. Washington: Government Printing Office, 1918.

THE NUTRITION OF THE FOETUS. By J. Morris Slemons, M.D., New Haven: Yale University Press, 1919.

REPORT OF THE SURGEON GENERAL, U. S. ARMY, TO THE SECRETARY OF WAR 1919. 2 vols. Washington: Government Printing Office, 1919.

CORRESPONDENCE

SURGERY OF TENDON TRANSPOSITION

To the Editor: Dr. Bernstein's paper "The Surgery of Tendon Transposition" published in the July number of SURGERY, GYNECOLOGY AND OBSTETRICS, deserves the study of all interested in tendon surgery. Just because of the thoroughness and care shown in its preparation, a word of criticism may not seem amiss. Dr. Bernstein divides the operations for tendon transfer into three types: in the first the tendon pursues a subcutaneous course, in the second (the Biesalski-Mayer technique) it is drawn through the sheath of the paralyzed tendon, in the third it is transposed with its own sheath. It is of the two latter that I wish to write, since my views concerning the first are in accord with Dr. Bernstein's.

Dr. Bernstein condemns the technique proposed by Biesalski and myself because, according to his animal experiments, adhesions form between the transplanted tendon and the sheath of the paralyzed tendon through which it is drawn. It is, indeed, true that at a secondary operation performed 17 days after the original transfer, I found delicate bands within the tendon sheath but these bore no resemblance to those depicted in Dr. Bernstein's microphotographs, nor were they clinically of sufficient strength to impede the free gliding of the transplanted tendon. The explanation of this discrepancy in our findings is probably due to the fact that the Biesalski-Mayer technique is far more difficult of exact execution on a dog than on the human patient, since owing to the minute size of the canine tendon sheath, more traumatism is almost certain to occur. It is possible also that Dr. Bernstein has not been using all the refinements of technique which have been introduced since my original publication.

One fact stands out quite definitely as a result of more than 250 operations, and that is that clinically, the tendons which are transferred by the intrasheath method function with hardly any exception almost as well as the normal.

The third method, namely the transfer of the tendon with its sheath has my full approval as an alternative method. This is a natural feeling on my part since Biesalski and I published this same technique over three years ago; it is to be found with illustrations in our monograph on "Tendon Transplantion," page 251 *et. seq.* It seems, therefore, to me somewhat unwarranted on Dr. Bernstein's part to consider this method particularly his own. My sole objection to it is its limitation to two or at most three operations. It is quite impossible to apply it to the transposition of the peroneous longus for a paralyzed tibialis anticus since the sheath of the peroneus longus is much too short. For the transfer of the extensor proprius hallucis, the method is adequate and has given excellent clinical results in all the cases in which I have employed it. Dr. Bernstein must not, however, think this technique preserves the blood vessels of the mesotenon intact; although the sheath is not opened, many of these vessels must be divided before the tendon sheath can be lifted away from the bone.

I wish again to emphasize what I have written in previous publications; that the physiological method is a term proposed for any technique in which due cognizance is taken of the normal anatomy and physiology of tendons. It is deeply gratifying to me, that Dr. Bernstein, Dr. Steindler and above all Dr. Bunnell, stimulated by modern tendon research, are trying to improve the methods proposed by me and through our united efforts further gain is certainly to be looked for.

LEO MAYER, M.D.
New York City

THE GAS DUMB-BELL

A Device for the Relief of Postoperative Flatus

To the Editor: Some seven or eight years ago I was operated upon for double inguinal hernia. On the day after the operation I began to be distressed by gas accumulations which would pass down into the rectum but which I could not expel because of total inability to use the abdominal muscles to overcome sphincter resistance. After a time the gas would gurgle back up into the colon and the tension become quite painful.

The usual rectal tube (of rubber) was inserted but furnished little relief, due, I discovered, to the fact that it curled up in the rectum. I called for a glass douche tip and found that by passing it just through the sphincter, easy outlet was provided for gas every time it was forced down into the rectum and thus large accumulations higher up were avoided. The distress disappeared.

The only drawback to the douche tip was that it easily slipped out and had to be frequently reinserted. This set me to thinking and I conceived the idea of having a tube made of glass in the shape of a dumb-bell which could be inserted through the sphincter and would be self-retaining, one bulb preventing it from slipping in and the other from slipping out. Having then passed the flatus period I did not have the chance of trying it out on myself, but as soon as I resumed my work I had a number of the dumb-bells made and have used them ever since on my postoperative cases with entire satisfaction. Inserted early — as soon as flatus begins to collect — they will provide complete relief in nearly every case, and they may be left in place any length of time without producing any discomfort whatever.

A supply of the tubes was provided for the use of Base Hospital No. 22 in France, where they had a good trial, and they are now in use in several of the hospitals here in Milwaukee.

Philip F. Rogers M.D. F.A.C.S.
Milwaukee, Wis.

AN APPEAL FOR HUMAN EMBRYOLOGICAL MATERIAL

To the Editor: In 1906 I observed certain malformations of the human shoulder-blade, and in contributions to current literature I have given them the collective name "the scaphoid type of scapula," and pointed out some of its hereditary, clinical, and anatomical significance.

Probably the most important observation connected with this type of scapula in man is its age incidence, that is to say, it occurs with great frequency among the young and with relative infrequency among the old. There appear to be two possible explanations of this fact: either (a) one form of shoulder-blade changes into the other during development and growth; or (b) many of the possessors of the scaphoid type of scapula are the poorly adaptable, the peculiarly vulnerable, the unduly disease susceptible—the inherently weakened of the race.

I have attempted to answer these questions by seeking evidence in various directions, and one of the most important of these has been a study of intra-uterine development of shoulder-blades. My investigations in this direction have been limited by the material at my disposal, which has been inadequate for a definite solution of this phase of the problem. I am, therefore, appealing to physicians for fœtus in any and all stages of human development.

It is desired that the material, as soon as possible after delivery, be immersed in 10 per cent formalin in a sealed container, and be forwarded to my address; charges collect. Due acknowledgment will be made to those forwarding material.

William W. Graves, M.D.

Metropolitan Bldg.,
St. Louis, Mo.

AMERICAN COLLEGE OF SURGEONS

THE NEW ADMINISTRATIVE HOME

On December 30th, 1919, final payment was made on the new administrative home of the American College of Surgeons and a deed to the property in the name of the College was delivered to its officers. This magnificent present to the College was a direct gift from citizens of Chicago —three-fourths of the amount subscribed by public-spirited men and women, and one-fourth by a group of the Chicago Fellows.

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1. The candidate shall be a graduate of medicine, licensed to practice medicine in his respective state or province, or accepted as a medical officer in the service of his country.

2. To be eligible for Fellowship without technical examination the candidate shall be a graduate of a medical school approved by the American College of Surgeons. If the candidate's school of graduation is not accredited by the American College of Surgeons, he may be required to pass a technical examination in one or all subjects of the medical curriculum.

3. The candidate shall give evidence that he has served at least one year as an interne in a creditable hospital and two years as a surgical assistant, or he shall give evidence of an apprenticeship of equivalent value. Five to eight years after graduation in medicine, devoted to special training and to practice, are normally the time-requirement for eligibility to Fellowship. Due importance is attached to laboratory and research work.

4. The ethical fitness and integrity of the candidate and his professional attainment shall be passed upon by the Credentials Committee of his state or province before he is entitled to take the examinations for admission to Fellowship as hereinafter described. To aid the Committees in this work, the Fellows of the College are asked from time to time for definite and impersonal reports concerning candidates in their respective states and provinces.

5. The professional activity of the candidate shall be limited to the study, diagnosis, and operative work in such specialty or specialties of surgery as the candidate may himself designate, as follows: First, if the candidate resides in a city of less than fifty thousand inhabitants, at least fifty per cent of his professional activity shall be limited to the study, diagnosis, and operative work in such specialty or specialties as stated. Second, in cities of over fifty thousand inhabitants, at least eighty per cent of the professional activity of the candidate shall be so limited.

6. The candidate shall make formal application for Fellowship. Blank forms for this purpose may be had, upon request, from the Secretary General of the College.

7. In making application for Fellowship the candidate shall sign a declaration which reads as follows:

"I hereby promise upon my honor as a gentleman that I will not, so long as I am a Fellow of the American College of Surgeons, practice division of fees in any form; neither by collecting fees for others referring patients to me; nor by permitting them to collect my fees for me; nor will I make joint fees with physicians or surgeons referring patients to me for operation or consultation; neither will I in any way, directly or indirectly, compensate any one referring patients to me; nor will I utilize any man as an assistant as a subterfuge for this purpose."

8. Surgeons widely recognized by the profession as leaders of progress and exponents of finished technique, by a unanimous vote of the Board of Regents, may be admitted to Fellowship on recommendation of the Committee on Examinations. Personal candidature for Fellowship on this basis, however, is not entertained. All candidates for Fellowship are requested to make formal application as described under Articles 6 and 7.

9. The examination in the art and technique of surgery consists of, first, fifty complete case-records to be submitted by the candidate of major work performed by himself; second, fifty case-records in brief abstract of major work for which he was responsible or in which he acted as assistant. For requirements in ophthalmology, see Article 10.

In order that this requirement be more explicit, the College has prepared a series of record forms which indicate, in a general manner, the data desired in so far as they are applicable to each case, and the form within reasonable limits in which these data should be submitted. These record forms are printed in Bulletin No. 2, Vol. IV. The College does not supply these forms.

The essential data for the fifty complete case-records are the identification of the case by number—the name need not be given; date of operation; personal history relevant to complaint; physical examination; diagnosis on which operation was based; operative record, findings at operation, and technique; laboratory and physical findings; post-operative diagnosis; complications of convalescence; follow-up record in so far as available. A summary of each case, as explained later, is also desired. The essential data for the fifty case records in abstract are the identification of the case by number and other data as outlined on the summary card (Form 1).

10. In addition to the general requirements for admission to Fellowship (except Article 9), the examinations in ophthalmology consist of, first, case-records; second, written examinations; and, third, clinical laboratory and oral examinations, or so much thereof as may be judged necessary:

a. Candidates in ophthalmology are required to submit twenty-five complete case-records in accordance with Article 9. Ten of these records should be of cases of ocular diseases and defects of varied character, including errors of refraction or muscle balance; external ocular diseases or diseases of the uveal tract or retina, or of the optic nerve, or glaucoma. The reports should show especially the reasons for the diagnosis and for the operative treatment, and the technique of operations.

b. The written examination will test the candidate's knowledge of the underlying principles or science of ophthalmology, including anatomy, embryology, physiology, physiologic optics, pathology, relations of the eye to other organs and diseases of the body.

c. The oral examination will include:

The external examination of the eye.

Ophthalmoscopy. (Candidates are requested to bring their own ophthalmoscopes.)

Measurements of errors of refraction.

Testing of the ocular movements and fields of vision.

Relations of ocular conditions to diseases of other parts of the body and their treatment.

Laboratory examination in histology, pathology, and bacteriology of the eye.

d. The time and place of examination will be determined from time to time by the Ophthalmic Credentials Committee.*

11. The Regents of the College reserve the right to alter, from time to time, regulations respecting the admission of Fellows to the College as they may deem proper.

FELLOWSHIP FEE AND DUES

The initial Fellowship fee and dues are stated under the two following provisions:

1. That the initial Fellowship fee of the College is $100, payable upon notification of election to Fellowship. The initial Fellowship fee of candidates whose applications were filed at the executive offices of the College before November 1, 1914, is $50.

2. That annual dues of the College are provided as follows:

a. That the annual dues of the Fellows of the College be $25, payable January 1.

b. That all Fellows who have subscribed $500 to the Endowment Fund of the College be exempt from annual dues.

c. That the total amount required in annual dues or other fees shall not exceed $500.

d. That the Board of Regents cancel the indebtedness of any Fellow of the College, without publicity, to whom, in its judgment, such dues are a hardship.

e. That no Fellow of the College be asked to contribute any fee whatever to the College, either after 65 years of age, or after he has retired from active practice.

*The Ophthalmic Credentials Committee of the College and the American Board for Ophthalmic Examinations are the same body. The personnel of this committee is: Representatives of the Section on Ophthalmology of the American Medical Association, Dr. Edward Jackson, Chairman, Denver, Dr. Edward C. Ellett, Memphis, Dr. William C. Posy, Philadelphia; of the American Ophthalmological Society, Dr. Hiram Woods, Baltimore, Dr. Myles Standish, Boston, Dr. John E. Weeks, New York; of the American Academy of Ophthalmology and Oto-Laryngology, Dr. William H. Wilder, Chicago, and Dr. Walter B. Lancaster, Boston.

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Thomas Meares Green	Wilmington
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Everett A. Lockett	Winston-Salem
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D. T. Tayloe	Washington

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Victor A. LaRose	Bismarck

OHIO

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Robert H. Butler	Bellefontaine
J. Hadley Caldwell	Cincinnati
Warren Deweese Coy	Youngstown
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Ira Oscar Denman	Toledo
William Gordon Dice	Toledo
Francis M. Fitton	Hamilton
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Harmon B. Gibbon	Tiffin
William Gillespie	Cincinnati
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Perry Firestone King	Alliance
Charles Andrew Langdale	Cincinnati
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Nelson P. Davis	Pittsburgh
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L. Webster Fox	Philadelphia
Ernest Laplace	Philadelphia
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William J. L. McCullough	Washington
C. C. Mechling	Pittsburgh
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Daniel S. Rice	Hastings
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MALIGNANT MYOMATA AND RELATED TUMORS OF THE UTERUS

REPORT OF 72 CASES OCCURRING IN A SERIES OF 4,000 OPERATIONS FOR UTERINE FIBROMYOMATA[1]

BY NEWTON EVANS, M.D., ROCHESTER, MINNESOTA

MALIGNANT tumors of the uterus comprise a numerically important portion of the malignant tumors in women. In the registration area of the United States in 1916 the malignant tumors of the uterus caused 23.4 per cent of all deaths from cancer in women (14). The larger number of the uterine cancers are, of course, epithelial cancers. Zacherl states that the proportion of non-epithelial malignant tumors of the uterus to carcinomata is 1 to 40 or 50. The records of the Mayo Clinic for the period of 1910 to 1918 show 22 border-line and malignant non-epithelial tumors of the uterus, while during the same period there were 873 cases of carcinoma of the uterus, a proportion of 1 to 40.

Notwithstanding this numerical disproportion there is in the aggregate a large number of malignant non-epithelial tumors encountered and reported. These, however, have received much less study than carcinomata of the uterus, and their pathology is poorly understood as compared with many other types of malignancy.

The literature on the subject is somewhat extensive, beginning with the writings of Virchow in 1860, and followed by papers by Ritter, 1887; Williams, 1894; Pick, 1895; Gessner, 1899; Weir, 1901; Jacobi and Wollstein, 1902; and others, who reviewed the principal features of the subject at the various periods. I shall not undertake to review this literature since excellent résumés have recently been written by Maroney, Geist, Proper and Simpson, and others. Kelly and Cullen in their book *Myomata of the Uterus* (1909) present a very interesting and informing discussion of the subject with a detailed description of a large series of cases.

Two questions with regard to the pathology of this group of tumors apparently have assumed great importance, namely: What is the histogenesis of malignant, non-epithelial tumors of the uterus? Do they originate in pre-existing fibroids? Most observers have concluded with regard to the first question that practically all spindle-cell tumors arising in the musculature of the uterus originate from smooth muscle cells and tend to differentiate into that type of cell. The most potent factors in helping to arrive at this conclusion have been the modern methods of studying and of differentiating the tissue cell types and, particularly, the application of the differential tissue stains of Mallory. The second question seems also to have been satisfactorily settled by the work of various observers who have demonstrated the existence of malignant myomata and cellular myomata within the structures of fibromyomata, other portions of which were of the

[1] Work done as a volunteer student in surgical pathology, under the direction of Dr. W. C. MacCarty, Mayo Foundation, April 16, 1919, to August 15, 1919.

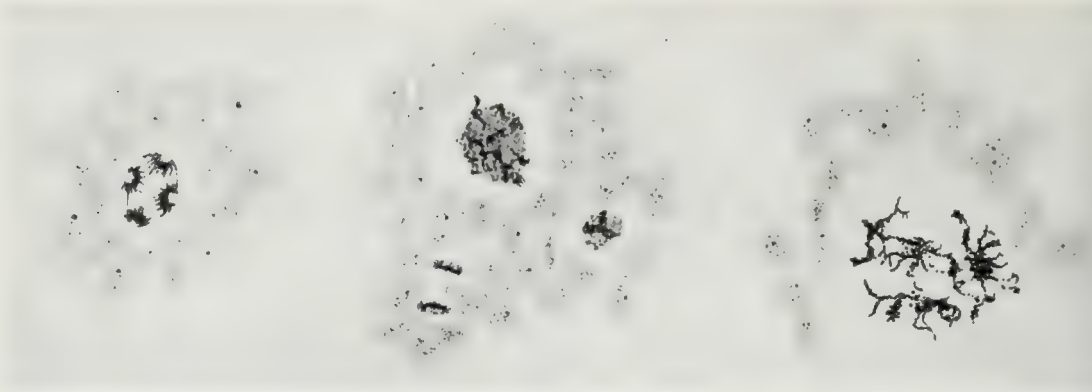


Fig. 1. Fig. 2. Fig. 3.

Figs. 1, 2, 3 and 4. Case 3, (125014). (Mitoses 7 000 in 1 cubic millimeter). Drawings of very large and atypical mitotic figures. Fig. 1 shows a very unusual form with four symmetrical rosettes.

ordinary benign tissue type. Williams, in 1894, gave this point careful study. The exhaustive work of Kelly and Cullen on their rather large series of cases also makes it plain that these tumors frequently originate within the structures of fibroids. The present observations lead to the conclusion that this insular transformation of otherwise benign fibroids is not usual, for it was not definitely evident in any of the large series of cases studied. It seems, therefore, that the tumor originates in the uterine musculature, and the structure remains unchanged, or that there is a gradual diffuse transformation in structure which leads to the formation found at the time of removal. This question in reality, however, is of academic interest only. The really important point is that these tumors appear as tumors, or within tumors which, clinically, and sometimes even at operation, cannot be distinguished from ordinary fibromyomata except in the very advanced stages of growth, when the extensive local infiltration and fixation of the tumor make it suspicious, or recognizable as definitely malignant.

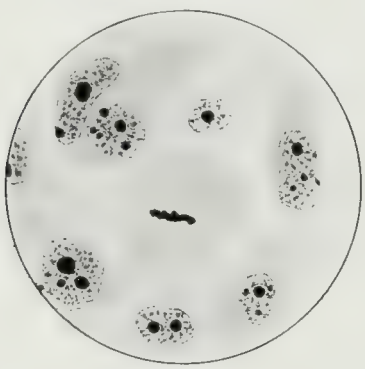


Fig 4.

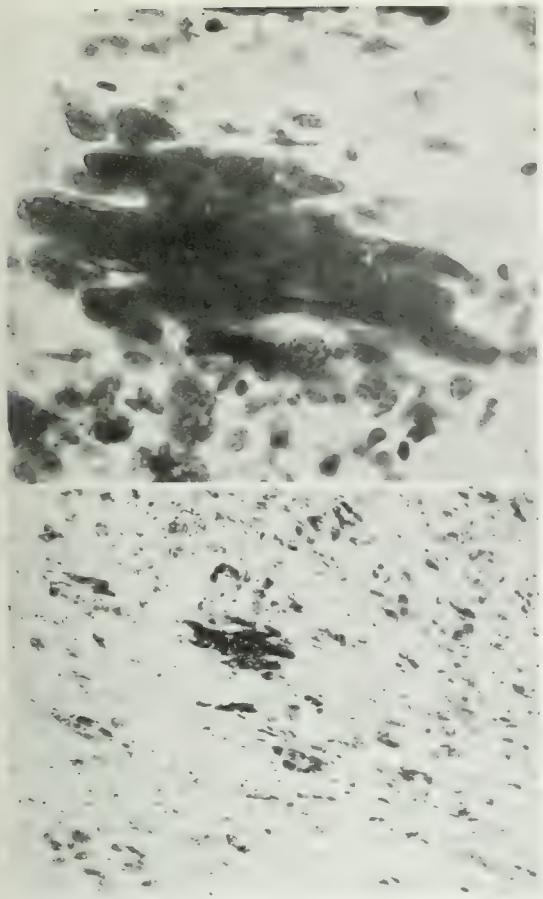
From a review of the literature in this field it is evident that there is a serious lack of understanding and agreement as to the histologic criteria which should govern the diagnosis of malignancy in this class of uterine tumors.

Kelly and Cullen found 17 cases among 1400 of uterine fibromyomata which they were willing definitely to denominate "sarcoma"; but in the same series there were 17 other tumors which they looked on as suggestive or suspicious of being sarcomatous.

Miller refers to the cases of Warnekross, who reported the surgical treatment of 7 cases of malignant myoma. Photographs of the tissues of these tumors were submitted to Aschoff who gave it as his unqualified opinion that in only 2 cases of the 7 could the tumors be classified as malignant.

In some of the numerous collected series of cases of uterine fibromyomata, the relative proportion which shows malignant change is given as low as 0.4 per cent; in others it is as high as 10 per cent.

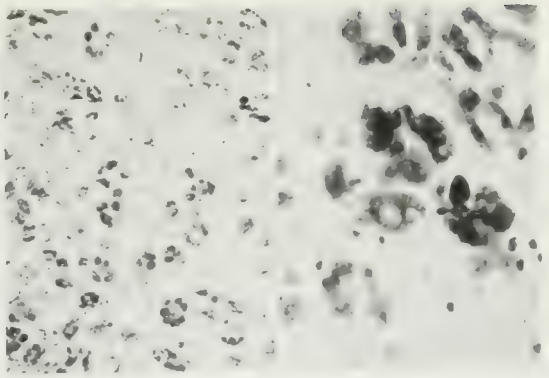
Maroney states that the diagnosis "must be a matter of individual interpretation in suspicious cases."



Figs. 5 (above) and 6. Case 20, (220035). (No mitoses.) Photomicrograph high and low power, showing structure of a giant cell tumor, with one giant cell of immense size. Note the size of the immense irregular nucleus with some of the surrounding nuclei of tumor cells of ordinary size, and the relatively large amount of fibrous stroma. Tumors of this type did not recur after removal (x 100 and x 500).

In view of this evident lack of knowledge and lack of acceptance of uniform standards of malignancy as well as degrees of malignancy in this class of tumors, the principal purpose of this study is to make such comparisons of the histologic findings and the clinical histories of the material available as will serve to contribute something to the establishment of microscopic criteria.

A composite picture of these characteristics, as has been presented in the writings of several authorities, includes the following points:



Figs. 7 (at left) and 8. Case 33, (248318). (No mitoses.) Giant cell tumor, with very large nuclei arranged peripherally in the giant cells. Much fibrous stroma. Large nuclei contain vacuoles (x 100 and x 500).

1. Increase in size of tumor cells, as compared with normal muscle or benign muscle tumor cells.
2. Shorter and plumper cells with nuclei more nearly oval than normal muscle or benign muscle tumor cells, rounded, and "vesicular" nuclei.
3. Inequality in size and irregularity in shape and arrangement of the cells.
4. Lack of "differentiation" of cells.
5. Unequal staining of nuclei, and deeply staining nuclei.
6. Presence of immense cells (protoplasmic plaques) with hyperchromatic, single, or multiple nuclei (giant cells).
7. Presence of mitotic figures, typical and atypical.
8. Decrease or absence of stroma fibers between the cells.
9. Thinness or absence of vessel walls.

Kelly and Cullen in the descriptions of their 17 positive cases of malignant tumors appear, from a histologic standpoint, to place definite dependence on inequality in size and increase in the size of the tumor cells; and it is evident that they do not look on the presence of mitotic figures or of numerous mitoses as essential to the diagnosis of malignancy in these tumors. In 6 of the cases "nuclear figures" are noted, in 9 no mention is made of their presence, and in 2 it is stated specifically that they were not seen.

Ewing, in discussing the relative malignancy of the different malignant myomata,

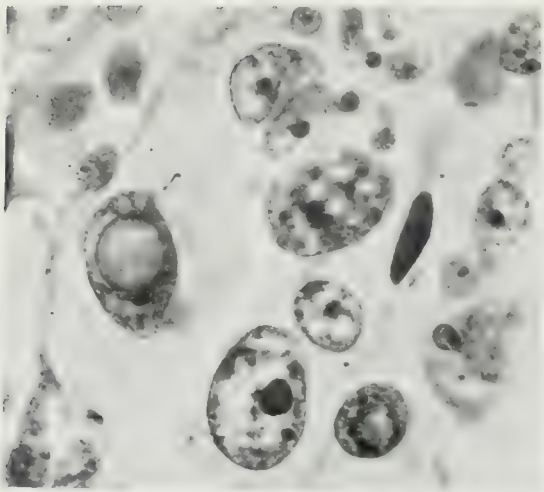


Fig. 9. Case 2, (77121) (Mitoses 2,400 in 1 cubic millimeter). Cells of immense size in a very malignant tumor. Very large dense nucleoli and nuclear vacuoles (x 500).

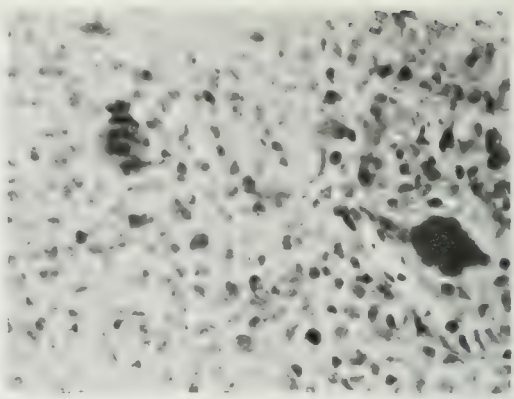


Fig. 10. Case 7, (64888) (Mitoses 2,560 in 1 cubic millimeter). Foreign body giant cells in a tumor with much fibrous stroma in its structure, but a highly malignant tumor (x 240).

says that the round-cell and the giant-cell structures are the most malignant.

Proper and Simpson, of the New York State Cancer Laboratory, in their recent article on "Malignant Leiomyomata," present an extremely valuable study of the microscopic characteristics of these tumors, since it is based on the correlation of the postoperative course of the patients with the microscopic structure of the tumors. They divide the tumors into three types varying in the degrees of malignancy which possibly represent stages of malignancy. With reference to their structure they state: "Histologically the tumors may vary from those made up of cells of uniform size resembling those which make up leiomyomata, but being somewhat shorter and plumper, with here and there a mitotic figure, up to tumors comprised of cells which are extremely irregular in size and shape, some being masses of protoplasm with giant or multiple nuclei, and showing all varieties of atypical mitotic figures." This statement seems to mean that the presence of the large irregular nuclei and giant cells is in direct proportion to the degree of malignancy and is an important accompaniment of the malignant process. This is in apparent accord with Ewing's statement. Proper and Simpson also make the very important observation that in doubtful cases they depend on the absence of mitotic figures as the criterion of a benign tumor. Mallory believes that the presence of mitotic figures in these myomata is a definite indication that they are capable of infiltration and are, therefore, malignant. Lockyer in his interesting volume on fibroids, recently published, says that malignant myomata are often difficult to distinguish and emphasizes the tendency to infiltrate and the presence of mitotic figures as a distinguishing characteristic.

The literature contains frequent accounts of metastasis by way of the blood stream of myomata which are said to have the structure of benign or ordinary fibromyomata. Lockyer refers to cases of this kind. Ewing states that, so far as he has been able to learn, no case has been fully studied in which definite variations from the usual structure were wanting, although in several instances these variations were not very pronounced. Strong is quoted by Maroney as making the very radical state ment relative to the existence of microscopic criteria for malignancy in these tumors, that the "only criterion is infiltration and destructive growth. Mere richness in cells, mitoses, and even irregularities in size of cell do not constitute sarcoma." Strong further states: "There never can be any absolute criterion for their malignancy and their interpretation will always be effected by the personal equation of the individual observer." Ewing, shar-

Fig. 11. Drawing of nuclei of tumor cells showing changes evidently those of direct nuclear division-amitosis. Series showing progressive changes in long, oval nuclei of ordinary size.

ing the uncertainty of practically all observers relative to the microscopic diagnosis, says: "Sarcomatous tendencies and precancerous changes do not constitute real sarcoma or cancer." It is thus evident that many "very cellular" tumors or myomata exist which give difficulty in classification as far as their real malignancy is concerned and which are sometimes classified by the pathologist as malignant, and sometimes as benign or doubtful.

Mitotic figures. From the foregoing statements and other observations it may be assumed that, in a general way, the presence in the tumor tissue of evidences of indirect cell division is looked on as a characteristic of the malignant growths of the types under consideration. So far as I can learn, however, no attention has been given to a determination in a given case, of the actual or relative numbers of mitotic figures as related to the degree of malignancy of the tumor, or whether or not any such relation exists. The facts presented in the present series of cases show that such relationship undoubtedly does exist.

This series comprises 72 cases diagnosed as "sarcomatous," "cellular," or "very cellular" fibromyomatous tumors in the Laboratory of Surgical Pathology of the Mayo Clinic in the years from 1906 to 1918 inclusive. All tumors of this kind observed in about 4,000 operations for the cure of uterine fibromyomata are included.

Table I serves to show the very definite relationship between the more evident characteristics of the cellular structure of the tumors, particularly the presence and relative proportions of the mitotic figures, and the clinical outcome of the disease. In each case

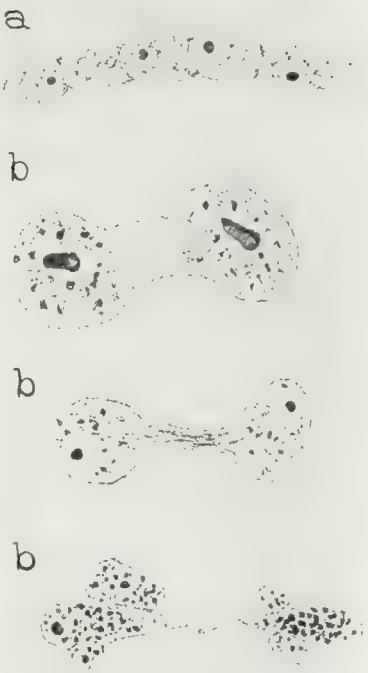


Fig. 12. Drawing *a*. Result of multiple change of a long nucleus. *b*. Forms seen in giant cells of tumors having no mitotic figures.

evidences of indirect cell division were searched for and careful estimates were made of the actual number of these figures in a given area of the tumor tissue; the numerical values were expressed as the number of mitotic figures seen in 100 microscopic fields of a 1/12th oil immersion lens. These values are also translated in an adjoining column into the number of dividing cells in a cubic millimeter of the tissue, taking into consideration in this estimation the thickness of the tissue section.

The tumors readily divide themselves into three definitely delimited groups, on the basis of the number of mitotic figures present. In the first 13 cases the tumors show from 2200 to 12000 mitotic figures for each cubic millimeter. Cases 15 to 25 form a group having from 200 to 800 in a cubic millimeter. In the remainder of the cases the tumors either contained no figures on examination or only a very few, one or two being found after long

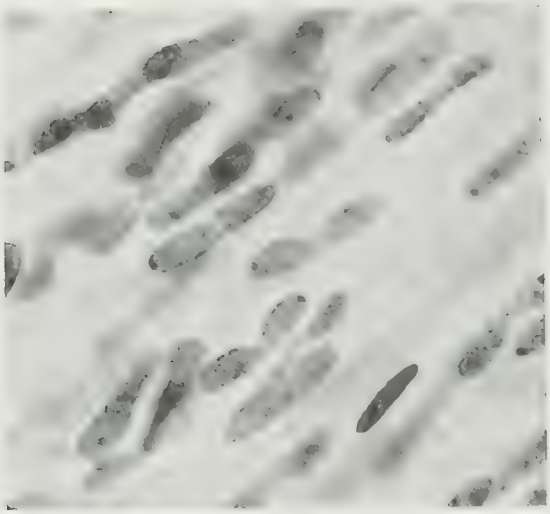


Fig. 13. Case 61, (248302). (No mitoses). Photomicrograph showing numerous long oval nuclei in direct division (x 1000).

searching. One of the most noticeable features of the tabulation is the definite numerical separation between the first and the second groups, no tumors being found which showed a numerical value between 800 and 2000. It would not be justifiable to conclude that in a larger series of tumors or in another similar series, values within this hiatus might not be found, yet the numerical distinction is so clear-cut that it cannot escape notice.

The real importance of such distinctions, however, becomes evident when the after-course of these cases is considered. Of the 13 patients in the first group, 11 had recurrences within periods of from 1 month to 18 months. Only 2 patients are known to be living; they give no indication of a return of the malignant tumor, 7 and 4 months respectively, since operation, periods too short to preclude the possibility of later recurrence. However, since the recurrences were rapid in the other cases, one is justified in hopeful prognoses in these 2 cases.

In definite contrast to the cases in the first group, in the 11 cases in the second group, having mitotic figures in the proportion of 200 to 800 to each cubic millimeter, there has been no mortality; at least in the cases about which we have been able to obtain a recent report, 9 of the 11, and there are good reasons for believing that the same is true in the other 2 cases.

In the remaining group of 48 cases, in which no mitotic figures are seen, or only a very few, there is no mortality from recurrence, at least in a large majority concerning which it has been possible to obtain recent reports.

This striking evidence of the importance of numerous mitotic figures as an indication of definite malignancy makes it desirable to study the reports of similar series of cases from this viewpoint. The very complete description of the histology and the clinical features of Kelly and Cullen's 17 cases makes an interesting comparison possible. Eleven of their 17 patients survived the operation and so are available for comparison on the basis of after-history. Only 4 of the 11 died of recurrence. In each of these 4, mitotic figures are mentioned as being present, in one "many" were seen, and in one other as many as "6 in a field." Of the remaining 7 patients without recurrence, only one tumor is mentioned as showing mitotic figures, and in this there was said to be "one here and there." One might be justified from a study of these descriptions in the opinion that the 4 fatal recurring tumors belonged in the same group with those of this series having many mitotic figures, and that the one tumor which had mitotic figures "here and there" belonged in the next group having fewer mitoses and clinically showing no recurrences. It might be questioned whether Kelly and Cullen are entirely right in classifying in their group of 17 definitely malignant "myosarcomata" the 9 cases which are not mentioned as showing mitoses, and 2 which are described specifically as not showing such figures. In none of these patients having tumors with no mitoses recorded, who survived operation, was there any recurrence.

A personal communication from Dr. Simpson relative to the series of 22 cases of this type of tumor recently reported by Proper and Simpson indicates that the findings of their specimens, with reference to the relative number of mitotic figures in sections of the tumors of their different histologic types, are substantially in harmony with my series.

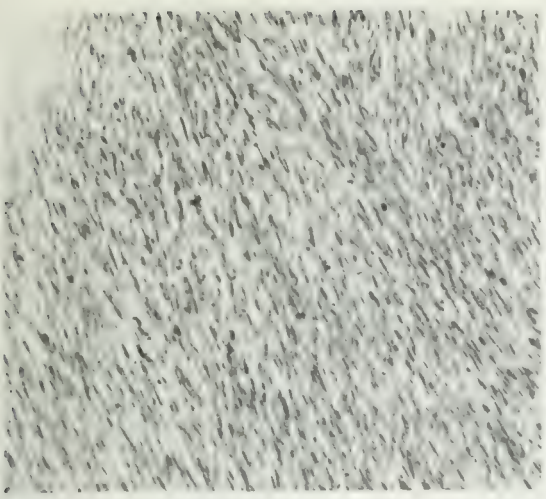


Fig. 14. Case 8, (38352) (Mitoses 4,000 in 1 cubic millimeter). Marked degree of polarity and alignment of the most malignant tumor as compared with the irregular arrangement of the cells in the less malignant tumor.

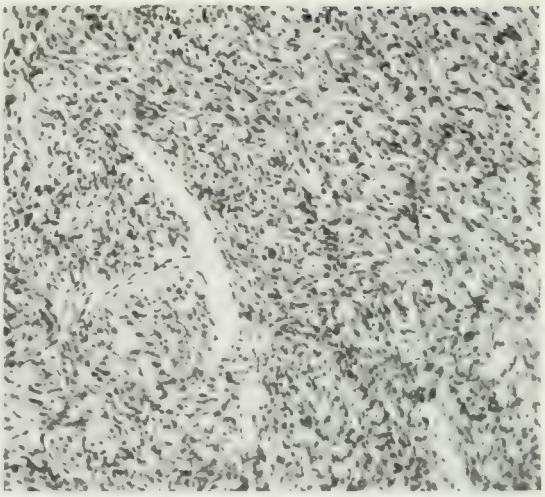


Fig. 15. Case 57, (21551) No mitoses. See figure 14.

While we are considering the question of mitosis it would be well to mention the frequent occurrence, in the tumors composed of a mass of very large sized tumor cells, of numerous mitotic figures of unusual form and gigantic size. The drawings in Figure 1 show several examples, including the unusual figure of a double division resulting in the formation of four newly formed symmetrical rosettes. These large and so-called atypical mitotic figures are unquestionably always a sign of high grade malignancy.

Giant cells and hyperchromatic nuclei. Another histologic feature which demands consideration in a study of these tumors is the presence in a certain proportion of them, of cells with large, irregular, hyperchromatic, and usually multiple nuclei. Some of these are so immense as almost to exceed belief (Figs. 2, 3, and 4). The importance of these changes in the diagnoses of malignancy or degree of malignancy, judging from the statements in the literature of the subject, is usually considered to be very great. A study of Table I will give a basis for rather definite conclusions in regard to this point.

It is true that in the first group of 13 cases, including all of those of the series in which there was postoperative recurrence, giant cells were present in varying degree, but in a considerable proportion of them in comparatively small numbers. Most of the tumors in the next group of the series (Cases 14 to 24), none of which recurred, tumors which were characterized by a relatively small number of mitotic figures, had no giant cells, and only a few had any giant cells. The phenomenon of greatest interest, however, is that in many of the tumors of the third group (Cases 25 to 72) giant cells were numerous and in a few tumors they were present in such numbers, and of such size and complexity as to attract attention. It should be remembered that in this group there were no recurrences and histologically the tumors were characterized by the absence of mitotic figures or by the presence of only a very few at the most. A review of the literature indicates that such tumors have usually been looked on as malignant. The facts evident in this series compel the conclusion that there is nothing to indicate that the presence of the giant cells alone is an indication of a high degree of malignancy or indeed of malignancy at all. In the tumors showing the greatest tendency to giant cell formation but without mitotic figures, it is invariably found that the cells are not closely packed but are separated by large amounts of fibrous stroma with a tendency to hyalinization. Kelly and Cullen believe that the frequent association of this

Fig. 16. Case 43, (76296) (Very few mitoses). Gross appearance of section through a fixed specimen of uterus containing multiple fibromyomata. One of the tumors, *a*, is very cellular. Its yellow color is indicated by the darker shade in the photograph. It contains an area of hæmorrhage.

type of cell and stroma indicates malignancy and that the presence of the hyalinization is an important factor in its pathogenesis. It may be concluded that these cellular changes are a phenomenon of degeneration coincident with fibrosis and hyalinization rather than a manifestation of the exaggerated productive and reactive phenomena which characterize real malignant tumors. The origin of the cells which take on this unusual type of change is somewhat uncertain but from the cellular relations it seems that many of these very large mononucleated and multinucleated cells are modified muscle cells while others, from their position in relation to minute vascular channels, appear to originate from endothelial cells.

The morphology of these giant cells is distinctly different from that of the so-called foreign body giant cells which are found in many tumors, in the lesions of the infectious granulomata, and in the vicinity of various

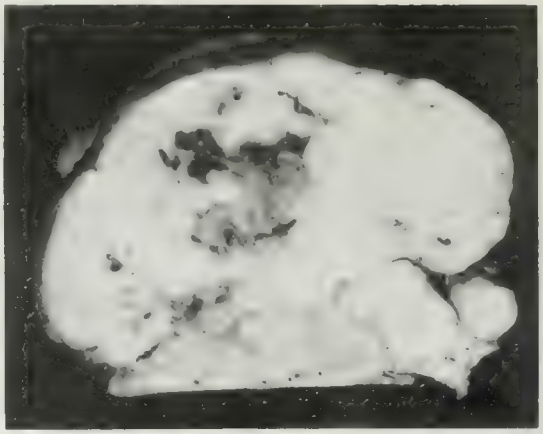


Fig. 17. Case 11, (213999) (Mitoses 12,000 in 1 cubic millimeter.) Natural size of a section through the fixed specimen. The smooth appearance of the cut surface is evident in contrast to the fibrous appearance of the ordinary fibroid.

foreign bodies in the tissues. Those appearing in the tumors in our series should be classed as true tumor giant cells. In a few of the tumors studied, however, there is a tendency to the formation of the foreign body giant cells. This tendency is marked in only one of the tumors (Case 7, Fig 5). In these figures numbers of giant cells of this type are scattered throughout various portions. They are characterized by a compact, densely acidophilic staining cytoplasm with numerous small oval or round nuclei centrally located. These cells probably have their origin in modified connective tissue stroma cells or in some type of wandering cell. In contrast with these cells are the characteristic tumor giant cells which have irregularly shaped, lightly staining, indistinct bodies with very large, unequally sized, irregularly shaped, deeply staining nuclei usually arranged in a ring at the periphery of the cell body. Many of these nuclei have very large densely staining chromatin granules, and often the chromatin is disposed in threads (Fig. 2). In many of the sections of the very malignant tumors many very large cells are found undergoing unusual forms of mitosis. But typical multinucleated giant cells with nuclei in the stages of mitosis have not been found. This leads to the conclusion that the true tumor, multinucleated giant cell forms by the direct, or

amitotic division of the nucleus. Such dividing nuclei are in fact frequently seen.

Direct cell-division of tumor cells. Throughout the tissue of a large proportion of these uterine tumors are seen nuclear forms, the morphology of which can be interpreted only as that of cell division by the direct or amitotic method. This is particularly true of those tumors which do not belong to the more malignant type, containing no mitotic figures, and the growth of which cannot be accounted for by mitotic cell division. The drawings and the photographs of nuclei thus dividing will give a general impression of the phenomena as seen in the sections. There are two distinct forms of such nuclear division. One of these is seen in the large nuclei of the large hyperchromatic giant cells described in the preceding paragraph. These nuclei may divide equally, but more often they divide unequally by a process of lengthening and constriction at the middle; the two portions are pulled apart, a large strand of nuclear material connecting them, thus assuming a distinct dumb-bell shape (Fig. 6). The other form of direct nuclear division is seen in the tumor cells of ordinary size, of long or short oval shape, or with rounded nuclei. The cleavage is usually preceded by a distinct indentation on one side of the nucleus before it is separated into two equal parts. The line of cleavage is in a distinctly oblique direction, the degree of obliquity being greater in the shorter and plumper nuclei (Fig. 7). Occasionally nuclei of great length will be seen evidently dividing almost simultaneously by a multiple cleavage so that a chain of attached oval nuclei results (Fig. 6).

The conclusion is apparently justified that the direct cellular division observed accounts for the tumor growth in the growing tumors which show no signs of growth by mitosis. The subject of amitotic cell division is discussed at some length by Wilson in his book on the cell. He emphasizes three points of special interest in this connection:

1. Cells undergoing amitotic division have a tendency to become larger in size than other cells of the same tissue type.

2. The cells have a tendency to nuclear division without division of the cytoplasm, thus producing multinucleated giant cells. Both of these tendencies are very definitely illustrated in the large nuclei of the tumor giant cells which so frequently characterize these tumors and especially those not showing definitely malignant tendencies.

3. Direct cell division is an indication of degeneracy of the cells involved.

On this last point Wilson quotes von Rath: "When once a cell has undergone amitotic division it has received its death warrant; it may indeed continue for a time to divide by amitosis, but invariably perishes in the end." Wilson states, however, that this is probably an extreme view as there are definite examples to the contrary in lower forms of life. It may be assumed, therefore, that the direct nuclear division which was so frequently seen in the tumors of this series undergoing fibrosis and hyalinization as well as the marked tendency to giant cell formation under the same conditions is a manifestation of biologically regressive cellular changes.

Kimura has recently reported an interesting and important piece of work which throws additional light on the problem of the relation of mitotic figures (or evidence of frequent indirect cell division) to malignancy. The purpose of his experiments is to show the influence of the X-ray on the growth and invasive power of malignant tumor tissue, using susceptible animals (mice) and artificial tissue cultures in parallel series. An appropriate dosage of X-ray rendered the cancer tissue incapable of invading the susceptible animals but the artificial cultures of the irradiated cancer tissue grew just as freely as the control tissue cultures. The remarkable fact was noticed that the tissue exposed to the X-ray grew in artificial culture without any mitotic figures, while the control tissue grew with large numbers of mitotic figures. The type of cell division concerned in the growth of the tissue which had lost its invasive power in animals must have been the direct or amitotic type. It seems that the process of mitotic cell division had some relation to the malignancy of the tumors and that with the loss of their mitotic figures they lost their invasive powers. These interesting results are in harmony with the facts observed

TABLE I.—TABULATED FINDINGS IN 72 CASES OF MALIGNANT MYOMATA AND RELATED TUMORS OF THE UTERUS

	Case	Mitotic figures		Cells	Giant cells	Operative death	Recurrence	Death after operation	Diagnosis at operation
		In 1/12 microscopic field	In 1 mm.	Size and shape					
1	33870	120/100	4800	2, spindle	Many	No	Yes	4½ mos.	Sarcoma
2	77121	60/100	2400	4, round, oval and mixed	Many	No	Yes	?	Sarcomatous
3	125613	190/100	7600	3, spindle and mixed	Few	No	Yes	9 mos.	Sarcoma?
4	207128	300/100	12000	3, mixed	Many	No	Yes	6 wks.	Spindle-celled sarcoma
5	230225	175/100	7000	2, round, oval	Many	No	Yes	12 mos	Mixed-celled sarcoma
6	55911	55/100	2200	2, spindle	None	No	No, 7 mos.	No	Sarcomatous
7	04888	64/100	2560	2, spindle, round	Foreign body	No	Yes	3 mos.	Degeneration and necrobiosis[2]
8	38352	100/100	4000	2, oval and mixed	Few	No	Yes	6 wks.	Sarcoma
9	111435	93/100	3720	3, round, oval and mixed	Few	No	Yes	1 mo.	Sarcoma
10	119219	141/100	5640	1, spindle, oval	Few	No	Yes	17 mos.	Necrobiosis[3]
11	213833	58/100	2320	2, oval	Few	No	Yes	2 mos.	Sarcoma
12	213999	300/100	12000	2, round, oval	Few	No	Yes	13 mos.	Sarcoma
13	255090	120/100	4800	1, mixed	Few	No	No, 4 mos.	No	Sarcoma
14	45051	14/100	560	2, round, oval	None	No	No, 9 yrs.		Degeneration. Fibroid
15	85077	5/100	200	2, round, oval	None	No	No, 3 yrs.		Myxosarcoma. Degeneration
16	103207	13/100	520	1, oval	None	No	No, 5 mos.		Sarcomatous fibroid
17	160459	10/100	400	2, round, oval	None	No	No, 3 yrs.		Angiomatous fibroid
18	176816	20/100	800	1, round, oval	None	No	No, 1 yr.		Sarcoma[4]
19	184003	17/100	680	2, round, oval	None	No			Sarcoma
20	186793	5/100	200	1, spindle, oval	None	No	No, 2¼ yrs.		Early myxosarcoma
21	201753	6/100	240	1, oval	None	No	No, 10 mos.		Spindle-celled sarcoma
22	224262	6/100	240	1, spindle, oval	None	No			Myosarcoma
23	230181	20/100	800	2, mixed	Few	No	No, 1 yr.		Myosarcoma
24	1591	8/100	320	Varies	Many	No	No, 13 yrs.		Sarcoma
25	93251	None	None	1, spindle, oval	Few	No	No, 3½ yrs.		Sarcoma?
26	187053	Very few		2, mixed	Few	No			Secondary hypertrophy
27	215251	None	None	1, mixed	Small areas	No	No, 1½ yrs.		Cellular
28	224819	Very few	..	1, spindle, oval	Few	No	No, 16 mos.		Fairly cellular
29	229035	None	None	Varies	Many	No	No, 14 mos.		Sarcomatous
30	238918	None	None	2, mixed	Few	No	No, 1 yr.		Myosarcoma
31	241253	None	None	2, spindle, oval	Few	No	No, 11 mos.		Fairly cellular
32	242747	None	None	2, mixed	Few	No	No, 11 mos.		Secondary hypertrophy
33	248318	None	None	2, mixed	Many	No	No, 10 mos.		Malignancy
34	265765	None	None	2, round, oval	Small areas	No	No, 3 mos.		Fairly cellular
35	6013	Very few	....	1, spindle, oval	Few	No			Sarcoma
36	9105	Very few	....	2, spindle, oval	Few	No	No, 11 yrs.		Sarcoma
37	37031	None	None	1, spindle, oval	Few	No	No, 9 yrs.		Sarcomatous degeneration
38	51398	None	None	1, spindle, oval	None	No	No, 8 yrs.		Sarcoma?
39	50317	None	None	1, mixed	None	No	No, 5 yrs.		Sarcomatous changes?
40	59792	None	None	1. mixed	None	No			Degenerative sarcoma?
41	54214	None	None	2, mixed	None	No	No, 7 yrs.		Sarcomatous degeneration
42	75009	None	None	1, mixed	None	No	No, 5 yrs.		Fibrous sarcoma or myosarcoma
43	76296	Very few	....	2, spindle and oval	None	No			Sarcomatous
44	88314	Very few	....	1, mixed	None	No	No, 6 yrs.		Sarcoma
45	94137	Very few	....	1, spindle, oval	None	No	No, 18 mos.		Sarcoma?
46	132034	None	None	2, mixed	None	No	No, 5 yrs.		Cystic degeneration.
47	170677	None	None	2, spindle, oval	None	No	No, 2 yrs.		Hæmangioma
48	180101	Very few	....	1, spindle, oval	Few	No			Secondary hyperplasia
49	136805	None	None	2, spindle, oval	Few	No	No, 2½ yrs.		Secondary hyperplasia.
50	189824	Very few	....	2, round and oval	None	No	No, 2 yrs.		Very cellular
51	194810	None	None	2, spindle, oval	None	No			Fairly cellular
52	197431	Very few	....	2, spindle, oval	None	No	No, 2 yrs.		Secondary hyperplasia
53	207489	None	None	1, spindle, oval	None	No	No, 9 mos.		Early myosarcoma
54	208263	None	None	1, spindle	None	No		Died 3½ mos.	Cellular
55	220310	Very few	....	1, mixed	None	No			Cellular
56	221532	Very few	....	2, mixed	None	No	Metastasis?		Early sarcoma
57	228619	Very few	....	2, mixed	None	No			Fairly cellular
58	228853	Very few	....	1, irregular	None	No	No, 15 mos.	No	Secondary hyperplasia
59	237287	None	None	1, spindle, oval	None	No			Cellular areas, secondary hyperplasia
60	243528	None	None	1, irregular	None	No	No, 1 yr.	No	Very cellular
61	248302	None	None	2, spindle, oval	Few	No	No, 7¼ mos.	No	Cellular
62	254173	None	None	1, spindle	None	No	No, 7 mos.	No	Myosarcoma[5]
63	258667	None	None	1, spindle, oval	Few	No	No, 5 mos.	No	Cellular, probably early sarcoma
64	258698	Very few		1, round, spindle	None	No	No, 5 mos.	No	Spindle cell sarcoma
65	258852	None	None	1, irregular	None	No	No, 5 mos.	No	Fairly cellular
66	259958	None	None	2, irregular	None	No		No	Early sarcoma
67	175048	No specimen				No			Fairly cellular
68	190610	No specimen				No			Fairly cellular
69	203331	No specimen				No			Fairly cellular
70	247404	No specimen				No	0 mos. ?		Cellular, degenerating
71	250107	No specimen				No	No, 9 mos.		Very cellular
72	207005	No specimen				No	Inoperable	14 mos.	No examination

(For footnotes see opposite page.)

in the group of malignant uterine tumors in this series since only those tumors which contained large numbers of mitotic figures were able so successfully to invade the tissues as to recur after removal.

Tumor cell differentiation. While it is true that in many of the more malignant of these tumors there is a decided decrease in those characteristics which are considered as signs of differentiation, still in practically all a greater or lesser degree of spindle shape, polarity, and alignment of the tumor cells is recognizable. In some of the most malignant this is very pronounced, much more so than in many of the cellular tumors which evidently have little if any real malignancy. This may be easily seen by comparing the appearance of the sections in Figure 8. Therefore, it is evident that the presence or absence of these characteristics is not an essential criterion.

The one dependable microscopic feature so far considered is clearly that of abundant mitotic figures in the extremely malignant cases. The question of the existence of other constant criteria should be considered. It seems to me that the most important microscopic features aside from the frequency of mitoses are:

1. The large size of the great mass of the tumor cells in a given case, and a marked inequality in their size. In those very malignant tumors which are characterized by this type of cellular structure many abnormally large mitotic figures are apparently invariably found (Fig. 1), and such figures otherwise unusual in their morphology.

2. The relative decrease in the amount of fibrous stroma.

3. The growth among the tumor cells of blood vessels with very thin walls or with walls entirely wanting.

4. The relative increase in the size of the nucleus of the tumor cells as compared with the mass of the cytoplasm of the cell body.

While all these changes are important, careful study of the material shows that none is constant, that is, invariably present in the very malignant tumors and always absent in those not malignant. Notwithstanding this fact it is well to note that the tumors composed of a mass of closely packed cells of very large size are invariably extremely malignant, although it is not true that all the malignant tumors have this particular morphology.

It would be rash to maintain that other constant, easily recognizable microscopic criteria of this particular type of malignancy do not exist; but up to the present time I have not been able to recognize any single criterion which is constant aside from the peculiarities in mitoses, although the presence of several of the prominent characteristics when occurring in combination may possibly be sufficient to insure the accuracy of the diagnosis of malignancy without giving any attention to the question of mitotic figures.

Frequency of occurrence. Reference to the literature indicates that frequently efforts have been made to estimate the incidence of the malignant non-epithelial tumors of the uterus as compared with the total number of cases of uterine fibroids. Table II gives an idea of some of the results. The wide variation in these estimates is no doubt largely due to the absence of uniform standards rather than to actual variation in the incidence of the malignant tumors.

The 72 cases in the present series in which the cellular and definitely malignant tumors are included were examined in the Mayo Clinic during the years 1906 to 1918 and 3 months of the year 1919, during which time operation was done in approximately 4,000 cases of uterine fibroids. However, in order

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FOOTNOTES FOR TABLE I

[1] The computation to determine the number of mitotic figures in a cubic millimeter of tumor tissue: Diameter of oil immersion field—0.170 mm.; radius—0.085 mm.; area of one field—(3.1416 times the square of the radius) 0.022698 sq. mm. Taking the average thickness of section as 0.011 mm. the cubic contents of one microscopic field would be 0.000249678 cmm. or approximately 0.00025 cmm., or 1/4000 of a cmm. Therefore having determined the number of mitotic figures in 100 fields the number in a cubic millimeter would be 4000 times the average number in one field or 40 times the number in 100 fields.

[2] A vaginal myomectomy. At first operation the malignancy was not discovered, but it was discovered at a second operation following recurrence.

[3] At first operation, a subtotal abdominal hysterectomy was done; the malignancy was not recognized. A second operation was done because of recurrence.

[4] In this case the removal of the tumor mass was not accomplished, but was discontinued before completion. A tube was left in the abdominal wound to facilitate radium treatments, of which the patient subsequently had a number; also X-ray treatments were given. The patient was alive at the end of a year.

[5] The patient died three and one-half months after the hysterectomy from an acute peritonitis, following a cholecystectomy; the death had no relation to the previous conditions.

[6] Fragments only removed. Tumor regarded as inoperable and not removed.

to obtain relative figures which will have much value as an indication of the real incidence of these tumors of varying degrees of malignancy, it will be necessary to make the comparison from material collected over somewhat shorter periods, since only during the past few years has sufficiently painstaking investigation been made of all the fibroids which are removed at operation to insure the recognition of practically all the unusual myomata, particularly those of the lesser degrees of malignancy. Among the 968 cases of operation for removal of fibromyomata during the two years 1917 and 1918, were 6 cases of the most malignant type, those tumors containing from 2,200 to 12,000 mitotic figures to the cubic millimeter. When the tumors having from 200 to 800 mitotic figures to the cubic millimeter are included there are 12 in all; and including all these with the remainder of the series, that is, those having the cellular structure but lacking the frequent mitoses, gives 38 in all. The percentage for the first group was 0.62, for the first and second groups together 1.25, for the three groups 4.00.

During the period from 1910 to 1918 inclusive the total number of fibroid operations was 3,297; only 13 cases (0.39 per cent) belonged to the very malignant group; adding the 9 cases of the second group, there are 22 cases (0.67 per cent). The figures for the third group of this longer period are too inexact to be included. When the figures for the two year period and those for the nine year period are compared the percentages for the shorter period are found to be definitely larger; and it is probably safe to conclude that these larger percentages more nearly represent true conditions.

A comparison of the percentages for the two year period with the figures taken from those of other observers, as shown in Table II, leads one to believe that in a rough way those series which give percentages less than 1 per cent are made up of only the most malignant tumors, those in Group 1. This would include such groups of cases as Broun's 1,500 cases at the Woman's Hospital, New York, and the 337 cases of Noble. Those series giving percentages between 1 and 2 are probably

TABLE II.—FREQUENCY OF NON-EPITHELIAL MALIGNANT UTERINE TUMORS AS COMPARED WITH FREQUENCY OF FIBROIDS

	Fibroids	Malignant	Percentage
Proper and Simpson	357	22	6 00
Miller	9780		1 96
Lewis	1518		1 40
Olshausen	6470		1 30
Kelly and Nolde	2274		2 00
Winter	500		3 20
Winter	273		4 30
Noble	337	2	0 60
Kelly and Cullen	1100	17	1 20
Martin	205	4	1 90
Lehling	100	8	1 10
Broun, Woman's Hosp., N. Y.	1500	7	0 40
Warner	100		
Including all "cellular"		7	7 00
Sarcomata" only		2	2 00
Geist	250	12	4 80
Present series	968	Group 1, 6	0 02
1917–1918		Groups 1 and 2, 12	1 25
		Groups 1, 2 and 3, 38	4 00
1906–1918	3297	Group 1, 13	0 39
		Groups 1 and 2, 22	0 67

made up largely of cases that would be included in our Groups 1 and 2. The higher figures are no doubt in series which include not only the more malignant types but also practically all of the cellular tumors, the majority of which manifestly show little malignancy clinically and, as we have shown, contain few or no mitotic figures.

Degrees of malignancy and relation of the different types of tumors. Three questions still remain to be considered. (1) The degree of malignancy of the tumors which are classified outside of the group of manifestly malignant tumors, but including tumors none of which recurred after removal (Groups 2 and 3). (2) The question of the biologic relationship between these less malignant tumors and the most malignant ones. Are they a fixed type of tumor, or are they simply in a stage of metamorphosis, representing a transition stage between the ordinary fibroid with its mature, fully differentiated type of cell and the real cancer? (3) Is it not possible that these very cellular myomata with short spindle cells and short plump nuclei and an occasional mitotic figure are simply ordinary fibromyomata in an actively growing phase, and at a later period may they not cease their active growth and become ordinary fibroids with the structure that the majority of fibroids possess? With regard to the last of these questions it seems possible that there may be a stage of growth in which the balance may turn in either direction, on the one hand,

back to the fully differentiated type and, on the other, to a still more active tumor growth in which the cells vary more widely from the adult type and in which the increased rate of growth and increased power to invade tissue is indicated by an increase in mitotic figures.

With regard to the first two of these questions the positive opinion seems justifiable, although not proved, that the actively growing tumors which contain an appreciable number of mitotic figures are in a stage of transition toward actual malignancy and, if undisturbed, will become malignant.

A tentative classification of the tumors of this series, exclusive of those in the first group, those definitely malignant, is as follows: Group 2 includes those with a mitotic figure, content of from 200 to 800 to the cubic millimeter and should be looked on as in a transition stage, border-line tumors between the definite malignant group and the remaining group of cellular tumors. The cases in Group 3 are premalignant and presumably have malignant tendencies.

Gross characteristics. These uterine tumors appearing in the locations of, and in form and general appearance resembling fibromyomata, have a color and consistency which as a rule are characteristic; and it should be remembered that they occur frequently in the uterine ligaments and other locations where fibromyomata are found. The color is difficult to describe but is remembered when once seen and recognized. It may be said to be a shade including pink, yellow, and gray. Fixed gross specimens have a yellowish tinge, which distinguishes them from the ordinary fibroid. The tissue is much softer and has a smooth homogenous cut surface as compared with the firm fibrous surface of the usual fibroid, and is decidedly more friable. In the definitely malignant forms the tumor mass is still more friable and varies in color, due to hæmorrhage and degenerative and necrotic changes. In most of the tumors of the definitely malignant type, the infiltration and destruction of the uterine and other pelvic structures involved is evident, but the less malignant forms are usually as definitely delimited from the surrounding myometrium as is the ordinary fibroid.

TABLE III.—MORTALITY PERCENTAGES FOR CONSECUTIVE OPERATIONS FOR REMOVAL OF FIBROIDS OF THE UTERUS

	Cases	Mortality Percentage
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
St. Mary's Hospital (Mayo Clinic, 1916, 1917, [illegible]	1188	[illegible]
[illegible]	[illegible]	[illegible]

Metastasis. Definite indications of metastasis to distant organs were not found in any of these cases. From the findings at operation and from the subsequent histories of the fatal cases there was evidence of extensive local and abdominal metastasis.

Clinical characteristics. The striking feature of the pre-operative history is its resemblance to the history of the ordinary fibroid case and the entire absence of any points in the history or physical examination which make it possible to suspect malignancy except in those cases in which the extension is so far advanced as to make operative cure or any other cure impossible.

In the first group, 2 patients only were living without recurrence, one 7, and one 4 months. One of these patients had the smallest tumor of the group, 2 centimeters in diameter; it was interstitial in location, without macroscopic evidence of infiltration, and it had the smallest number of mitotic figures of any of the tumors included in the group, 2,200 in the cubic millimeter. The other patient reported no signs of recurrence 4 months subsequent to operation. The tumor in this case was large, subserous, pedunculated, 17 centimeters in diameter, and adherent to the omentum. Not including the very small tumor just mentioned there were 2 cases in which the tumors were located interstitially; they showed no definite macroscopic evidence of infiltration beyond the uterine body. Both of these, however, recurred and were fatal

As compared with other types of malignant tumors non-epithelial uterine tumors are said to be comparatively low grade in malignancy. This seems to be true in so far as metastasis in distant organs is concerned. In the present series definite indication of distant metastasis was not found in any case. But from the standpoint of rapid and extensive

infiltration these tumors must be classified as extremely malignant.

A comparison of the ages of the patients in the different groups of the series at the time of operation shows that as a group the patients with very malignant tumors averaged 50 years, while all the others averaged 40½ years. The patients included in Group 2, with the border-line tumors, averaged 41 years. A rapidly growing tumor at or after menopause is very suggestive of this type of malignancy.

Treatment. Five cases in this series were treated postoperatively with the X-ray and radium, but the after-histories indicate that no cures were accomplished in those cases in which the operative and microscopic examinations indicated extreme malignancy. One case (Case 18) is of special interest in this connection. The tumor microscopically belonged to the group of border-line or transition tumors having 800 mitotic figures to the cubic millimeter; at operation such extensive adhesions were found that the tumor could not be removed. The patient was given prolonged X-ray and radium treatment. After two and one-half years she is alive and apparently well with some regression of the tumor.

The present plan of surgically removing all uterine fibroids of appreciable size seems to be the procedure of choice. The low operative mortality figures which are shown by the work of skilled surgeons in the better hospitals are an argument in favor of the operative method.

In the present series of 72 cases there were no operative deaths. This remarkable absence of fatalities in a group of cases of so serious a nature must be looked on in a degree as accidental as is indicated by the usual operative mortality percentages in operations for fibromyomata.

Terminology. Several different names have been used to designate the malignant nonepithelial tumors of the uterus of the type discussed. Among these may be mentioned "sarcoma," "myosarcoma," "myoma sarcomatodes," "leiomyosarcoma," "myoma malignum," "malignant leiomyoblastoma," "malignant leiomyoma," and "malignant myoma." In the interest of a uniform terminology it seems well to use the term "malignant myoma."

SUMMARY

There is evident need of the establishment and recognition of histologic standards of malignancy in the classification of the nonepithelial uterine tumors.

In the present study the only single constant microscopic evidence of definite malignancy is the presence of large numbers of mitotic figures.

Many of these tumors have numerous large giant cells with multiple hyperchromatic nuclei which are often looked on as evidence of malignancy, but they do not contain mitotic figures. There is no evidence that such tumors are malignant.

In the less malignant tumors not containing numerous mitotic figures there are morphologic evidences of division of tumor cells by direct cell division.

Clinically the majority of patients with definitely malignant tumors present themselves for treatment about the climacteric or later. The tumors are difficult to distinguish in the earlier stages from ordinary fibromyomata; they are not cured by X-ray or radium, and the surgical removal of all fibroids of any appreciable size seems to be the best treatment.

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TREATMENT OF TUBERCULOUS OSTEO-ARTHRITIS BY BONE GRAFTS

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SURGEONS of a few years' experience have had occasion, as time has gone by, to review all the modifications, each one less mutilating, of the methods by which tuberculous osteo-arthritis has been treated. We have passed through the stages of amputation of the diseased limb above the lesion; total resection of the diseased joint—extirpated as one would extirpate a tumor—and atypical resection, the diseased portions being carefully sought out in the articulation and adjoining bones in order to extirpate them, interfering as little as possible with the cartilaginous line of growth and leaving the bony surfaces in shape thereby facilitating the formation of a new joint.

As regards the treatment in the majority of cases, we have today cast all these methods aside, but we should not overlook them when the patient has reached the fistulous stage with resulting destruction of bone and soft parts, when he is in a state of cachexia, and especially when he is an aboriginal in whom the lack of hereditary immunization does not assist in the localization of the tuberculous lesion, the basis of all conservative treatment. A study of the different operations which have been used has taught surgeons the pathology of the disease. It has demonstrated the various zones of the process and the marked venous congestion which exists in tuberculous epiphyses, lesions which are very clearly seen when presented in the pathological anatomy of the living subject.

Deep cauterization as an alterative for destroying the tuberculous foci, finally provoking cicatricial sclerosis of the lesion; the filling up of curetted cavities; and above all, the use of modifying subcutaneous injections which suffocate and silence the focus sometimes by surrounding it with connective tissue, at other times by surrounding it with fluid, thus making it more easy to draw off the products of the infection by repeated puncture—these are all processes which, we may say, introduce a new period in the history of the treatment of the disease.

The treatment with tuberculin—a biological process practically dominating all former methods—heliotherapy, and rest are today procedures which have proved very successful according to our statistics. These methods have placed an efficacious means of treatment in the hands of any who persistently follow a consistent program of application. The technique is quickly mastered even by

those who have had not much medical experience. All this is an advantage.

The present method of treatment is non-radical or non-surgical. However, since it requires 3 and 4 years to effect a cure, I have been interested in trying to discover some surgical means by which the time could be shortened.

To form a basis for judgment it has been necessary to study the exact causes of the local pathological processes and of the spontaneous cures produced by the more efficacious therapeutic procedures.

Let us first study the etiology and pathology of a diseased joint. The description I shall give is a little schematic, but it embraces the conception of the development of tuberculous osteo-arthritis as it is presented in the majority of cases of slow progress which are the more frequent.

I will touch briefly on the osseous formation of the epiphysis. The epiphysis is composed of spongy tissue, which is limited on one side by the cartilaginous line of growth and on the other by the articular surface. This surface is not entered by large vessels at any point but receives its blood vessels only from the periosteum covering the lateral and peripheral surfaces of the bone, which is reinforced by the capsule of the joint, ligaments, and tendinous insertions near which there are also blood vessels. Hence, when the capsule is overdistended by articular effusion, its vessels are also distended and thus because of their lessened lumen the blood supply to the epiphysis is diminished.

Throughout life the osseous system is constantly active in a struggle between the osteoblasts, which form bone, and the other elements peculiar to the marrow, the marrow cells and the myeloplaxes, the latter of which give way to the osteoclasts, destroyers of bone; and it is owing to the greater production of osteoblasts that the bone develops in the child. Later, in the adult, the osteoblasts and osteoclasts are produced in equal amounts. In old age, the bone becomes thinner, due to the excess production of the osteoclast. Success in the struggle sways from one side to the other in the different pathological states of the bone marrow.

The embolism which localizes in a bone and which generally comes from a primary focus, especially from a lymphatic gland, provokes a tuberculous marrow infection, that is, the bone marrow is sown with tubercular follicles which undergo mucous degeneration. Its elements become embryonic in type, and its peripheral capillaries are for the time being dilated while the central capillaries near the focus, in which abound tuberculous follicles undergoing caseous degeneration, are obliterated. These lesions produce a rarefying avascular osteitis in the trabeculæ of the bone, which is also toxic and partly due to the osteoclast.

The result in the competition of both systems—which, as I have said, are always active and in reciprocal action throughout normal and pathological life—is that the more rarefying the osteitis becomes the less is the intratrabecular marrow helped in its struggle to smother the invader; it is overcome and the tuberculous process gains ground, and therefore the alveoli, every day becoming larger, give better protection to the roots, as I may put it, of the granulations which, once the cartilage is destroyed or raised, penetrate into the synovial cavity sowing it with tubercles.

These predominant lesions of rarefying osteitis are accompanied by a very accentuated venous stasis and by a reduction of the blood supply through the epiphyseal arterioles, due to œdema of the periosteum, to a distention of the soft periosticular tissues and to lesions of mal-position following on reflex muscular contraction—causes which act more especially on the venous walls, which are more depressible than those of the arterioles, which are already contracted by the action of the tuberculous toxins.

To sum up, we have venous stasis, little flow of arterial blood, extravasated liquids, sluggishness in metabolism, lesions of mal-position through reflex muscular contraction, and rarefying osteitis. All this assists in the formation of the granulations.

Let us see how the more efficacious therapeutic measures, rest and heliotherapy, act.

Rest, and here the best results are obtained from continued extension, acts as a depleting

Normal knee.

Tuberculous knee 10 days after operation

agent by uniformly compressing, through the medium of the soft tissues, the articulation and the epiphyseal surfaces, facilitating the reabsorption of the extravasated liquids in the œdematous tissues which have undergone embryonic transformation. Therefore, it facilitates, by compression, the circulation of the blood, it lessens the venous stasis for this reason and because it eliminates the congestion that mal position has provoked through reflex muscular contraction. This contraction is overcome by continued extension.

Heliotherapy, apart from its action on the phagocytosis and its general tonic effect, acts as an alterative, since it is well known that the more the skin becomes pigmented the more efficacious is the treatment, and with this augmentation of pigmentation, it fills the part of the lampblack of the apparatus used in physical science, which allows luminous heat to enter and not to pass out when it loses the former characteristic becoming non-luminous. This alterative provokes dilation of the vessels, greater rapidity in the blood circulation and therefore reabsorption of exuded liquids which overwhelm the diseased tissues and which prevent an efficacious interchange of nutrition and the very effective phagocytosis in the struggle against the tuberculous process.

The cautery, by which Charcot has already cured several cases of spinal cord compression due to vertebral osteo arthritis, has proved a good method of replacing effective alterative processes. But this is not so far-reaching as heliotherapy and is more transitory and discontinuous; there is, moreover, always a danger of secondary infection.

Now, by therapeutic action we can facilitate an alterative procedure in the periphery of the diseased articulation, increase the arterial circulation and lessen the venous stasis, eliminate the malformations, increase the nutritive interchange and reabsorb the exuded liquids.

In this manner we help the normal tendencies of the organism to encyst, to sclerose Koerner's tuberculous follicles, the tuberculous unit, in whatever site or tissue it develops. That is to say, we are fighting against tuberculous myelitis, and if we find any means which fills this function and opposes a

rarefying osteitis, the pathogeny of which has been shown to be propitious in the progress of the disease, we shall have reached the point in our program which surgical intervention must complete in the spontaneous cure of the disease.

I have devoted much time in seeking some method of biological procedure to complete this program, and more than two years ago I decided on the use of the bone graft. I plan above everything to protect the tuberculous tissue, not to touch it, but to work at some distance from it, although I know that the graft will live even in caseous material and within the zone of tuberculous medulitis. Hugh McKenna, of Chicago, did not hesitate to curette the central spongy tissue of a spina ventosa, placing within the cavity an autogenous graft to fill it, and he obtained a successful result. In spite of this I have concluded that if I place the graft outside of the tuberculous tissue my results will be good, for the graft bed would be better here than if placed in the diseased tissue.

A bone graft is today the form of graft that gives the best results, for it is full of vitality, and is easily adapted to the form which we wish to give it, and we have complete control over it for several years.

In 1915, I was appointed official investigator on the theory of "Bone Grafts in Pott's Disease" to report my findings at the extraordinary session of the Society of Pediatry. Commenting upon 18 cases operated upon by me in my surgical ward, I gave the following conclusions as to the points in technique which my experience had taught me were essential to obtain successful results:

1. Autogenous grafts.
2. The most rigorous asepsis possible.
3. Careful preparation of the bed in vascularized tissues, obtaining a meticulous hæmostasis to avoid the formation of clots between the bed and the graft, for the clots would form a barrier preventing the capillaries from penetrating the graft.
4. Rapidity in transplantation, removing the portion to be grafted with a gouge only when the bed for receiving the graft has been prepared. A saw must not be used for removing the graft, since necrosis of the superficial layers of the graft would be caused by the heat produced by sawing and above all because of the production of bone saw dust which would obliterate the openings of Haver's canals, preventing the penetration of the graft by capillaries. The gouge must be well sharpened so as not to exceed the elastic play of the osseous trabeculæ when they are being compressed for resection.
5. No foreign body (suture thread, etc.) must touch the graft, which should rest to the greatest possible extent in the subcortical osseous tissue, that is to say not only below the periosteum but below the cortex of bone. However, it must never extend to the center of the marrow.

The subcortical bone fulfills these two last requirements: (1) that of vascularized spongy tissue and (2) that in process of forming new bone; whereas the cortical bone tissue is already more condensed. In the marrow there are two principal elements, one of vascularized and the other of fatty material, which later, on being traumatized during the severe operation of being compressed with the graft, give rise to large hæmatomata impeding or retarding the capillary penetration of the graft, producing necrosis of the graft, whereby it is reabsorbed.

6. Immobilization of the region operated upon. In the last bulletins of the society of surgery of Paris, for the sessions of 1918 and 1919, there appear the contributions from French and foreign surgeons giving the results of surgical experiences in the war, and I notice with satisfaction that they do not add a single detail to the conclusions formulated by me five years previously and which I have since confirmed not only in treating Pott's disease but in treating fractures, pseudoarthrosis or ununited fractures, etc.

Convinced of the effectiveness of the use of bone graft when properly applied, we will see how it can be utilized to accomplish our above mentioned purpose, taking into full consideration the new pathological conditions, such as are found in this disease.

1. Because of its trophic action, the graft has the virtue of producing in the surrounding area condensing osteitis, improving the power of latent ossification, which is especially

abundant in bones in which there is some inflammatory process such as tuberculous epiphysitis, which we know weakens when it is not assisted and ends in total rarefying osteitis. Hence it occurred to me to use a sheet of bony tissue placing it within the epiphysis. This would produce a condensing osteitis, and the lessening of the diameters of the osseous alveoli would, so to speak, suffocate the roots of the granulations which had previously taken ample hold but which under the new conditions would atrophy.

2. The graft, placed so as to extend from the diaphysis to the epiphysis without touching the articular cavity, would cross the cartilaginous line of growth and as Haver's canals of the graft are rapidly and abundantly penetrated by capillaries, they would serve to overcome the venous congestion and carry arterial blood to the epiphysis. We observe also that the perforation of the cartilaginous line of growth by the bone graft depletes the venous congestion. This, as I have said, is easily established for the epiphysis is practically isolated from the circulatory current, as its articular and diaphyseal faces, covered with cartilage, do not permit the passage of vessels and veins, which go out through the lateral parts of the epiphysis and then are compressed by the œdema of the periosteum. To produce and maintain an active, permanent, and aseptic deviation of the blood current—such as can be secured by means of heliotherapy and which is better than that produced by means of the cautery—and thus combat the epiphyseal venous congestion, I place two lateral grafts in the cellular subcutaneous tissue surrounding the articulation so that there are points of implantation in bony sites at both extremities of the grafts. These grafts are at once copiously penetrated by capillaries thus depleting the central congestion by the aspiration which this rapid peripheral circulation produces.

It is scarcely necessary to say that I do not contend that the grafts fill from the first day the varied rôle my conception assigns to them. Therefore, while they are growing, I continue for 3 months the application of extension, bandages, and weights, which have been put on 15 days before intervention so that it will not be necessary to perform the operation in the presence of an active tuberculous lesion. After three months the patient can get up, wearing light plaster bandages which keep the joint immobile.

During all this time, the lateral grafts have been growing and from the size of a toothpick they have become in 6 months of the breadth and thickness of a rib. I study the course of the disease by roentgenograms which show clearing up of the rarefying osteitis; and by palpation which shows that the granulations and the pain have also disappeared. At this stage I remove the subcutaneous lateral supports and within 10 or 12 days after this slight operation I turn the patient over to a masseur for treatment to bring back mobility to the joint. The joint is not very stiff as in the latter days play on the normal axes of the articulation has been possible, as muscular contraction no longer exists and the lateral grafts have molded their extremities into angular shape thus acting as a pivot.

In the first four cases of osteo arthritis I used the X-rays several times. I had to lessen the dosage after the first case, since the rays produced in it a radiodermatitis with ulceration of the skin that doubtless had an untoward effect on the bony and peri-articular tissues, as there was great limitation in the movements of the knee. However, the limb is in such a position that it makes a useful pylon.

I have given up the X-rays in my later cases and now am using moderate heliotherapy, more as a matter of hygiene and as a general tonic than for its local action. Although it is an aid, I do not consider it to be indispensable.

From the first days following intervention, an improvement can be noted, improvement in the general condition, increase in the color of the mucous membrane, disappearance of the yellowish tint in the skin, and a better appetite. These are all indications of the lesser quantity of tuberculous toxins produced and absorbed in the focus, and to which I called attention 5 years ago when treating upon Albee's graft in Pott's disease.

Since that time I have maintained that it is especially in cases of accentuated tuberculous

cachexia that operation is urgent, for there is produced at a distance from the tuberculous focus, as in breaking the spinous processes of the vertebræ, a traumatic irritation of the periosteum and the fractured body tissue, a process which is alterative, interfering with the venous congestion which exists in the tuberculous focus of the diseased vertebra, and brings about less production and less absorption of toxins.

PERTROCHANTERIC FRACTURE OF THE FEMUR

By ABRAHAM O. WILENSKY, M.D., New York

A SOLUTION of continuity of the femur, in which the line of fracture is situated at the angle of junction of the shaft and neck of the bone and passes through the great trochanter, is so uncommon that up to the present writing there have been very few authentic cases reported in the literature. A summary of the cases follows:

The first of these is described by Sir Astley Cooper in his book published in 1844. The patient was an old man and the fracture was sustained in falling. Union with good function resulted. Some time later, after discharge from the hospital, the man died of some intercurrent fever and the specimen of the fracture was obtained at the postmortem examination (Fig. 1).

The second case was described by R. W. Smith in 1854. The fracture followed a fall by a man of 70 years of age. An infectious process developed at the seat of fracture which resulted in death five days after the accident. The specimen of the fracture was obtained postmortem (Fig. 2).

Three cases are mentioned by Bennet in 1895. The clinical details are not well given; the illustrations are not very clear.

In the same year five cases are figured and described by Kocher. The name "pertrochanteric fracture" is employed for the first time. Previously the lesion had been called—and is still so called—by Stimson "fracture through the great trochanter and neck."

In the first of Kocher's cases the injury was sustained in falling backward and the line of fracture passed obliquely from the outer side and anteriorly, downward, posteriorly and internally. After healing, the neck of the bone protruded at a right angle from the shaft; except for this no other deformity can be distinguished in the illustrations. In the second case the injury followed a fall in which the man's body struck the ground on the side of the body opposite to the hip fractured. The line of fracture followed a very similar plane to that described in the first case, and the resultant deformity is almost identical.

Three other cases similar to one another are described. In each the mechanism is that of forcible extension in the dorsal direction in falling backward; and the line of fracture passes from above and in front downward, backward, and to the inner side. In healing, the lower ends of the upper fragments are all rotated forward on a transverse axis, so that a perceptible anteroposterior angulation is present at the point of union; a coxa vara is present owing to tilting up of the trochanters (Figs. 3 and 4).

A very excellent example of this fracture is present in the United States Army Medical Museum. I am indebted to the Surgeon General's Office for the following notes:

"While in a state of intoxication, was being assisted to his quarters by two comrades, pulled himself violently from them at the head of the stairs, and fell over the railing to the pavement below, a distance of 13 feet. He was taken to the hospital at once, when he was found to be suffering from concussion of the brain, in the stage of collapse. Reaction soon came on, when it was found that he had sustained an injury at the right hip-joint supposed, at first, to be a dislocation,

Fig. 1

Fig. 2.

Fig. 1. Cooper's case.
Fig. 2. Smith's case.

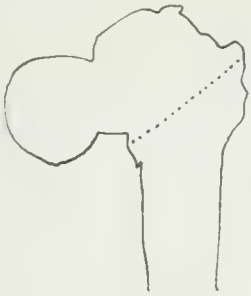

Fig. 3.

Fig. 4.

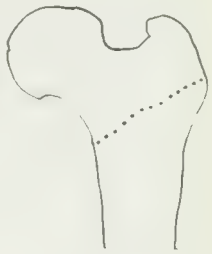

Fig. 5

Figs. 3, 4 and 5. Three of Kocher's cases. The X-ray photographs of Kocher's other cases as reproduced in his paper are not very clear.

but after manipulation under ether, was decided to be a fracture, the exact nature of which was not fully determined until after death, when it was found that a fracture extended through the trochanter-major and base of the neck of the femur, being partly extracapsular and partly intracapsular.

". . . . . It is believed that he struck the stone pavement on his right foot, producing both the fracture and concussion (Fig. 5)."

Stimson describes a personal case as being somewhat atypical in that the line of fracture "was very long and oblique, extending from the top of the trochanter downward and inward to a point . . . . . thought well below the lesser trochanter." The line of fracture was confirmed by exposure during operation. The patient, a man of fifty years, recovered with little, if any, shortening.

A case is mentioned by Gerster in his paper on the nail-extension treatment of fractures. The patient was 65 years old and healing of the fracture occurred in five months' time.

In a classification of 55 cases of fracture of the neck of the femur, McGlannan notes 3 as being pertrochanteric fractures. The patients were all laborers between 40 and 60 years of age and the fractures all healed. No other details are given and the X-ray photographs are not reproduced.

Below is the report of an additional case which, was recently admitted to my service at the Beth David Hospital.

The patient is a man of 65, who sustained the injury in falling on the street. Apparently he fell backward and landed on the side of his body and on the involved hip. There was immediate and total disability.

The first examination was made in the hospital one week after the injury. The limb was perceptibly shortened and markedly everted; the shortening amounted to between 3 and 4 centimeters. A large swelling was present over the outer side of the hip and, on palpation, the tumefaction seemed to consist of a much displaced trochanter. The most marked point of tenderness was at a point corresponding to the mid line of the thigh on a level with the fold of the groin. There was no ecchymosis of the skin. The tentative diagnosis was a fracture at the upper end of the shaft of the femur involving the trochanter major. The character of the visible deformity, the marked eversion, and the absolute loss of power indicated that the fracture was probably not impacted; the assumption was confirmed by the X-ray picture.

The roentgenogram (Fig. 6) showed the typical line of a pertrochanteric fracture. The fracture begins near the upper extremity of the trochanter major and passes downward, inward, and backward to terminate just at the lower margin of the trochanter minor; the line of fracture is parallel to the anterior intertrochanteric, or spiral, line. The fractured surface of the lower fragment looks upward, backward, and inward toward the median line; the corresponding surface of the upper fragment looks downward, outward, and somewhat backward owing to a tilt of the upper fragment. There is a sliding displacement of the shaft upward and outward so that the superior margin, or apex, of the trochanter major has moved obliquely upward and outward for more than an inch from its relative normal position while the fractured surfaces still remain in contact for their greater parts. There seems to be no subsidiary lines of fracture. The texture of the bone does not indicate any excessive amount of rarefaction, perhaps not even as much as one would ordinarily expect to find present in a man of the patient's age. There are no other lesions present in the immediate neighborhood demonstrable in the roentgenogram.

At my request the fracture was reduced and immobilized under traction by my associate Doctor Brody. Immobilization was effected by a plaster hip spica including the leg and foot. This method was preferred to an extension apparatus because it was feared that the latter would not work efficiently with this particular patient. After two months the cast was removed and an X-ray examination demonstrated that the fracture had united firmly and with a large amount of callus. Within a comparatively few days the man was able to elevate the leg actively while lying in bed and, thereafter he was permitted to walk with the aid of crutches. These, also, were quickly discarded and at the end of three months the man walked very well but with a slight limp. The residual shortening amounts to between 2 and 3 centimeters.

The anatomical end-result is shown in the accompanying roentgenogram (Fig. 7). The shaft of the femur rides higher than usual, but owing to the fact that the fractured surfaces are in contact, and that during the process of healing the latter remained parallel to one another there is no other anatomical abnormality. The angle between the neck and the shaft of the bone has, for the latter reason, not been disturbed and no true coxa vara deformity can be distinguished in the X-ray photograph; it is likely that this normal relationship will continue permanently because of the abundant callus not permitting any bending of the neck and any resulting lessening of the angle between the latter and the shaft. The broadening of the total transverse diameter of the hip is incidental and abduction is limited thereby to an inconsequential degree because of the outward flare of the ilium to which the tip of the trochanter is opposed, and by which motion in abduction is limited; the extent of the limitation is proportional and equal to the diminution of the arcs of circles as one progresses from the lower border of the flare of the ilium upward and outward to its crest.

We were all much impressed with the rapidity with which the fracture united and with the relatively large amount of callus which formed. If nothing else this would seem to distinguish this variety of fracture from those of the neck of the femur. In the latter, when the fracture is not impacted, healing, when it does take place, is tedious and prolonged; nor does one see such a relatively large amount of callus. Fractures near the base of the neck and in the trochanters may be entirely extracapsular while those in the neck proper usually open the joint capsule for a variable distance or are intra-articular. The significance of the latter complication on the want of, or on the character, the extent, and the rapidity of cicatrization and ossification seems settled and the majority opinion leans toward the assumption that the open communication of the fracture with the interior of the joint has no material effect on the progress, or lack of progress, of union of the fractured surfaces. With the neck fractures it seems that the difficulty lies in an adequate and efficient reduction and fixation of the opposing fragments in an anatomical position favorable for healing; in the pertrochanteric fractures the possibilities of attaining this purpose are much more easily accomplished. A most important reason for the frequent non-healing of unimpacted fractures of the neck of the femur is to be found in a relative minimum blood supply in the head and neck of the bone, as compared to a relative abundant blood supply in the trochanters and in the upper part of the shaft.

In all of the reported cases of pertrochanteric fracture the injury followed a fall. In all, except one case, the fall was directed backward; in attempting to recover the normal balance from the relative hyperextension of the lower limb at the hip-joint, an extraordinarily powerful pull is directed at the upper end of the bone in which all the lines of force converge and are concentrated in the plane corresponding to the lowermost limit of attachment of the Y ligament of Bigelow; the fracture necessarily results at this level. In the exception—one of Kocher's cases—the fall was directed toward the side of the body away from the implicated hip. The mechanism must necessarily include a powerful leverage by adduction of the entire lower extremity, a fulcrum and point of resistance having first been established by fixation of the upper end of the bone by the Y ligament; again the fracture must occur in the same plane. In our case the man fell backward but, in falling, the body turned so that he landed on his side and on the hip. In addition to the hyperextension the mechanism probably included a twisting force which found its minimum resistance in the line of fracture. I am rather inclined to believe that the direct impact of the hip against the ground had little to do with the fracture; I am led to this opinion from a consideration of the mechanisms in the other cases.

Fig. 6. Taken before reduction and immobilization.

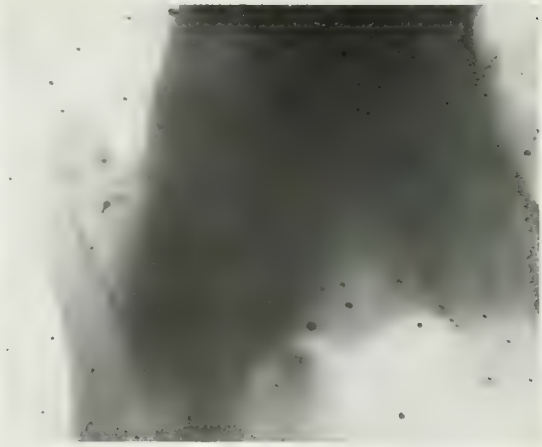

Fig. 7. Two months after immobilization.

The Y ligament of Bigelow seems to be one of the most important factors in the production of a pertrochanteric fracture. Of all the structures in the immediate neighborhood of the fracture, this ligament is the strongest and most unyielding; in all the varieties of fracture and dislocation—and the latter injuries are most severe and are caused by extreme degrees of violence—it is found intact. So dependable is the ligament that all the methods of reduction of dislocations of the hip are built upon the theorem that the structure always remains intact and can be used as a fulcrum by, and upon which, the end of the bone can be levered into place. In producing the fracture under discussion it seems most probable, as indicated previously, that the injury results from a play of force in which an extraordinary overextension of the trunk at the hip-joint occurs in the dorsal direction with, and upon, the lower limb as a relatively fixed pivot; an enormous strain is transmitted through the unyielding Y ligament which, while incidentally aiding the muscles very powerfully in fixing the upper end of the bone, at the same time determines a line of greatest weakness and least resistance in the bone. In attempting to recover the balance the long flexor muscles of the thigh are very strongly contracted and a powerful stress is exerted across the length of the femur which has the tendency to bow the femur in a forward direction. A sufficient continuation of the indicated stress and strain results in a solution of continuity, and the latter must necessarily take place at the line of least resistance, determined by the Y ligament, which corresponds with the lowermost line of attachment of its fibers a little below the junction of the neck and shaft of the bone at approximately the linea aspera. That is the typical line of a pertrochanteric fracture.

Mathematically considered the plane of greatest weakness in the femur corresponds accurately with the plane of atypical pertrochanteric fracture. Mechanically, the anatomical structure in the neighborhood of the hip, and including the thigh and trunk, is essentially that of a cantilever beam : a relatively rigid upright, AB Figure 8—the shaft of the femur—supports at its upper end one extremity, A, of a beam, AC, fixed at an angle, BAC—the neck and head of the femur—and at the opposite end, C, of the latter a weight—the trunk—is carried. The force constantly exerted at any point of the beam—technically known as the "bending moment" and which in our discussion would correspond to the force necessary to produce a fracture at any given point of the beam—is equal to one-half of the weight carried, multiplied by the perpendicular distance between the point of application and the point of fracture of the beam. In the given instance the weight is carried at the extremity of the

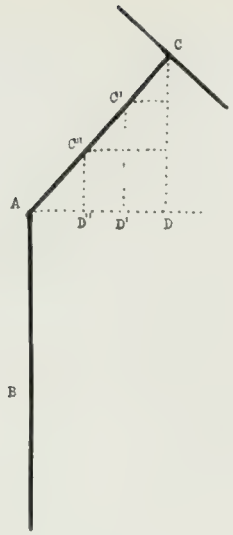

Fig. 8.

beam, C, and the perpendicular distance (l) between the point of application and point of support corresponds to the length AD. Algebraically it is indicated as follows:

$$M = \tfrac{1}{2} W. l \quad (1)$$

in which $l = AD$ (2)

$$\therefore M = \tfrac{1}{2} W. AD \quad (3)$$

At any given two points on the beam C' and C'', in which C'' is nearer to the point of support of the beam, the bending moment exerted from the point of application of the force at C grows progressively greater the nearer the point of fracture, C' or C'', approaches the point A which is the point of support of the beam. This is so because

For C' $l' = DD'$ (4)

and for C'' $l'' = DD''$ (5)

$$DD' < DD'' \quad (6)$$

and if the values are substituted in equation (1) given above we obtain

for C' $M' = \tfrac{1}{2} W. DD'$ (7)

and for C'' $M'' = \tfrac{1}{2} W. DD''$ (8)

$$DD' < DD'' \quad (9)$$

$$\therefore \tfrac{1}{2} W. DD' < \tfrac{1}{2} W. DD'' \quad (10)$$

or $$M' < M'' \quad (11)$$

Progressing further it follows that the point A must necessarily be the point where the "bending moment" exerted from the point C is at its maximum—in other words where the structure is at its weakest. This is so because

for C' $M' = \tfrac{1}{2} W. DD'$ (12)

for C'' $M'' = \tfrac{1}{2} W. DD''$ (13)

and for A $M''' = \tfrac{1}{2} W. AD$ (14)

$$AD > DD'' > DD' \quad (15)$$

$$\therefore \tfrac{1}{2} W. AD > \tfrac{1}{2} W. DD'' > \tfrac{1}{2} W. DD' \quad (16)$$

or $$M''' > M'' > M' \quad (17)$$

Dispensing with the technical terms and applying the result to the anatomical problem the calculation indicates that the weakest part of the support furnished by the thigh lies at the point of junction of the neck and shaft of the femur.

As regards the position of pertrochanteric fractures in the general classification of fractures of the femur, it seems to me that Cotton takes the best view. All fractures in the general neighborhood of the trochanters and the base of the neck are made to conform to one of three types. Types A and B are complicated forms of intertrochanteric fractures with subsidiary lines of fracture running in various directions. Type C corresponds to what is described in this communication as a pertrochanteric fracture. All of these types have the valuable characteristic of healing promptly and efficiently.

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THE ORIGIN OF TUMORS OF THE OVARY

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THIS article is but a résumé of a larger work which will appear shortly in monograph form. A review of the literature involves a colossal work and can be referred to only in a very cursory manner in a contribution of this nature. Suffice it to state that the more one delves into the subject the more is one confused with the multiplicity of views and the number of structures from which tumors within the ovary may arise. Some authors have dealt with embryological studies of the ovary, and others have given their attention to determining the origin of tumors, but seldom has any one author taken up the second portion after having acquired a good knowledge of the first by his own research. It is quite impossible to determine the origin of epithelial tumors, unless one knows the structures from which these tumors may arise.

It is my purpose first to describe the epithelial structures found in the normal ovary, and having determined this origin and development then to pass on to consider the origin of tumors.

The work then divides itself into two headings:

1. The origin of epithelial structures in the ovary.

2. The origin of epithelial tumors of the ovary.

I. THE ORIGIN OF EPITHELIAL STRUCTURES OF THE OVARY

It is impossible to understand the reason of many epithelial structures found in the adult human ovary except by a careful and painstaking study of the human embryo at various stages of its development. Human embryos, well preserved and fit for serial sections, are difficult to obtain, and after most careful study of those at my disposal I had to have recourse to comparative embryology to find the origin and nature of many epithelial structures. Comparative embryology has not only the advantage of material easily obtained in a fresh state, but also the advantage of presenting the phenomena of ovarian development in a much clearer sequence of changes. That these phenomena are the same in the higher vertebrates and in the human species cannot be doubted.

This work is based upon sections both serial and non-serial from ovaries of 127 individuals of all ages from a few hours to 80 years, as well as upon serial sections of five human embryos. The comparative study covers roughly 15,000 sections, mostly serial, from the cow, pig, sheep, cat, mouse, rabbit, guinea-pig and the dog and from embryos of the cow, dog, pig, and cat.

It would be impossible to overemphasize the importance of serial sections. In many instances my most obvious conclusions, drawn from the study of a single slide, suffered a complete contradiction by a mere glance at the neighboring slides in the series, and it is possible readily to realize that the conclusions of many authors would never have been put on paper, had serial sections, and not single slides, been at their disposal.

For purposes of comparative study leading to a better knowledge of human histology and embryology, there are no two other domestic animals so useful as the cow and the dog and their embryos, and since it was the generative organs of these two which led to this research it will best serve my purpose to confine descriptions to these species, describing others only when corroboration or elucidation are necessary.

A careful study of the mammalian ovary leads at once to the important fact that from a developmental point of view the resemblance between the ovary and the testis is a very striking one. There is nothing in the testicle that has not had at some time in embryonic life its homologue in the ovary. It therefore follows that of the structures that

are permanent in the testicle, some are transitory in the ovary and disappear completely, others degenerate but do not disappear, still others, remain but are modified to suit a modified function. The female embryo having developed more or less perfect testicles, progresses still further by destruction, modification, and addition. It is the development of all the testicular elements and their subsequent incomplete atrophy which has made of the ovary such a fertile field for the development of epithelial tumors of the most varied types.

What makes the ovary of one mammal differ most from the same organ of another mammalian lies in the amount of atrophy which ensues after the ovary has reached its full structural development. Of all the species examined, the cow, the bitch, and the cat suffer the least amount of atrophy. Hence, for this very reason they are exceptionally convenient for developmental study.

Until recent years it was almost unanimously thought, chiefly due to the teaching of Waldeyer, that the germinal epithelium of the ovary never penetrated farther than the outer cortical third of the organ. Whatever glandular structures were found within the hilus or medulla of the ovary were thought to be due to the invasion of the ovarian stroma by the tubules of the wolffian body. The wolffian body or mesonephros was consequently divided into two portions: that which invaded the ovary was called the genital portion, whereas that outside the boundaries of the ovary was called the urinary portion of the wolffian body.

Comparative study of adult ovary. If we examine almost any section from the ovary of the bitch, we find an unexpected wealth of epithelial structures. These, at first, seem to be without order and of several types. In the heart of the ovary, frequently in the midst of the great blood channels, we find the rete ovarii.

The rete ovarii. This structure corresponds to the rete of the testicle. It is an irregular tortuous gland-like structure, with numerous folds of its mucous membrane, which is lined for the most part by a columnar epithelium. The structure in some animals suggests a low grade of malignant carcinoma. The cavity of the rete varies much in size in different species. In my series the sheep present a very small rete ovarii, ofttimes difficult to find in the center of the ovary. In the dog and cow it is a large structure, often extending almost from pole to pole of the ovary as it passes on its tortuous course between the main blood vessels.

In the human the rete ovarii varies considerably in size in different individuals and even in the two ovaries of the same individual. In one of my cases one ovary is a mass of fœtal remnants without ova, whereas the other contains thousands of ova without any trace of fœtal remnants except the diminutive rete. We must look upon the rete as a fœtal remnant, and its atrophy and complete disappearance is quite the exception. In my numerous specimens a careful search has always resulted in finding a rete though at times it is quite diminutive and might readily be overlooked. But in several of the ovaries from the sheep I have not been able to find a trace of it.

The medullary cords or rays. In the ovary of the bitch there are numerous solid cords or tubules which course in a very irregular manner from the cortex to the center. Their arrangement generally speaking is radial though very irregular and convoluted. In the multiplicity of cells which line them or compose them, one may distinguish three dominant types.

The lining which conforms with the first type, consists of tall shaggy cells with a wide base and shrunken body prolonged into a thin protoplasmic filament which not infrequently passes across the lumen to join with a similar process from a cell of the opposite side. The nucleus is near the base. This type of lining is found chiefly in the tubular rays. At times a fold starting from the periphery of the tube, causes on transverse section an appearance suggestive of a polypus projecting into the lumen. This is also covered with a similar type of cell and the fibrous core, usually hyaline and without nucleus is joined by a thin velamentous fibrous tissue with the connective tissue at the periphery of the ray.

The second type is found in the solid cords. The dominant cell is syncitioid in type and in its functionless state resembles very closely the syncitioid cells of a young placenta that has been retained *in utero* for a short period after loss of function. The third type is less commonly found and resembles a true glandular duct, lined by cubical epithelium. These three types when traced through serial sections pass at times almost imperceptibly the one into the other. At other times the change is abrupt especially after an acute bend or tortuosity of the tube.

In serial section many of the rays are found to communicate at one end with the rete ovarii. The distal end of the ray is lost in the periphery of the ovary.

Development of the epithelial tissue of the ovary. I will not go into details of length and age (probable) of the various fœtus. These matters have little or no bearing upon the subject. The first sign of the development of the genital organs is found in a heaping up of the epithelium at a spot on the genito-urinary ridge. Immediately under this, at this early stage, lies the wolffian body with its ducts and glomeruli. This heaping of epithelium constitutes the germinal layer or the germinal ridge. Its origin, so far as is known, is from the peritoneal or mesothelial surface, and it lies to the inner side of the mesonephros. (A second genital ridge appears slightly later to the outerside of the wolffian body. This eventually gives rise to Mueller's duct. Slight confusion arises here owing to the varied nomenclature used. Some authors apply the term germinal epithelium to the whole covering of the wolffian body, while others restrict it to that portion which gives rise to the ovary. I shall use it in this restricted sense.) This is the beginning of the genital gland—the testes or ovary. Soon this epithelium begins to burrow and to arrange itself in columns coursing more or less at right angles to the surface, and running toward a narrow hilus. During this development the ovary has gradually become pedunculated.

If we now turn our attention to the embryos of the cow at various stages of their development, we find that at one time the ovary and testicle form a pedunculated structure which occupies the inner side of the wolffian body. To the outer side lies the differentiated tissue which is destined to form Mueller's duct, the forerunner of the fallopian tube. Between these two structures lies the large wolffian body with a wide base of attachment posteriorly. Its main excretory duct, the wolffian duct, lies slightly to the inner side of Mueller's duct. From the inner surface of this excretory duct many tubules take origin, then run along the outer surface of the wolffian eminence, then they bend suddenly upon themselves, their lining epithelium begins to stain more readily with eosin, the cells become much larger and the tubules themselves become very much twisted and finally end in a glomerulus, near the inner surface of the wolffian body. A small artery issuing from the main arterial trunk in front of the vertebra passes into the wolffian body at its attached border, courses along its inner free margin to end in the vascular tuft of the glomerulus. Separated by only a very short distance from the uppermost glomeruli, the fibrous tissue of the ovary takes its origin from and becomes continuous with the fibrous tissue of the wolffian body. The glomeruli are more or less arranged in a single row and therefore, their convex surface, where it is pierced by the glomerular artery, lies in toward the ovary. Except at both poles of the ovary, the space between Mueller's duct and the hilus of the ovary is quite wide and rounded, filled in by the enormously developed tubules of the wolffian body. So far no differentiation of ovules is visible. The cells of the whole ovarian surface seem to be uniform. They consist of deeply staining cells which resemble more or less ordinary lymphocytes. In an embryo of slightly more advanced age, we find remarkable changes have taken place. The growth of cells from the germinal layer of the ovary is no longer restricted to the immediate surface of the ovary, but has penetrated into the medulla and fills the hilus, and, separating the fibrous tissue which seems to form a capsule for them, they pass as deeply staining branching cylinders of tissue out of the hilus and along the wolffian body between its

free border and the glomeruli. These cylinders gradually grow smaller in extent as they travel along the wolffian body to end at a point near the free border of the mesosalpinx between the outer pole of the ovary and the fimbriated end of the tube. In their passage along the wolffian body they enter into intimate contact and become continuous with the cavities of at least two and may be as many as six of the glomeruli of the wolffian body. They are separate and distinct from the wolffian duct throughout their whole course, and enter into contact with it only through the interposition of the tubules and glomeruli of the wolffian body. There is, therefore, direct continuity between the surface epithelium and the wolffian duct through the medium of the medullary cords or tubules, the rete ovarii, the wolffian glomeruli tubules and duct.

So far as my experience goes, in no other animal can this be studied to such advantage as in the embryos of the cow. At this stage there is no differentiation of the ovarian epithelium tissue into tubules or ducts. It presents a deeply staining cellular structure, the cells of which possess a minimum of cell protoplasm with a deeply staining nucleus like that of a lymphocyte. Nothing could be more striking than the contrast between this darkly stained band of germinal epithelium and the adjoining tissues of the wolffian body. The latter is made up of large cells with a large amount of protoplasm which stains very deeply with eosin. At this stage of development, primordial ova are distinguished within Pflueger's tubules.

Slightly deeper toward the center of the ovary, in what I may designate as the second zone, or zone of medullary rays, solid and hollow strands, continuous with Pflueger's tubules, present themselves with primordial ova in their lumina. These are the forerunners of the medullary cords. Still farther toward the center these tubules in the medullary cords pass insensibly into a richly tubular structure rete ovarii which passes out of the ovary to pursue its course, which I outlined above, and to enter into contact with the glomeruli and glomerular ends of the wolffian ducts. In short, what was formerly a mass of darkly staining cells slowly and insensibly differentiates itself into tubules, by that same process by which Pflueger's cords differentiate themselves into Pflueger's tubules and the medullary cords into medullary tubules. In the ovary, as in the testicle, the continuity, therefore, is complete from the surface epithelium of the ovary to the wolffian duct. The parts nearest the germinal epithelium have to do with the generation of the reproductive elements, the remoter portions are the conduits along which the ova would travel if they pursued the same course as spermatozoa in the male. But in the female, ova are cast off into the peritoneal cavity and the efferent tubules become useless and atrophy completely or in part. Are all these parts maintained in their integrity through fœtal into postnatal and into adult life? The answer is decidedly in the negative, and it is the atrophy which ensues in the ovary owing to the ova pursuing a different route of migration which has led to so much confusion. A study of the adult organ cannot give any connection whatsoever between these various parts of the one and the same system owing to the complete atrophy of intervening links.

It must not be assumed that the extra-ovarian portion of the canals reach as complete a development in all other species as it does in the embryo of the cow. For example, in the human the extra-ovarian portion of the efferent ducts is relatively small and atrophies easily, so that only that portion remains (for some time) which is necessary to effect a junction with the wolffian ducts. Such were the conclusions to which my work led me, namely, that there are no parts in the testicle which have not their homologous parts at some time in embryonic life in the ovary.

These homologous parts may be clearly represented thus:

TESTICLE	
1. Seminiferous tubules	Of germinal epithelial origin
2. Vasa recta	
3. Rete testis	
4. Efferent canals	Of wolffian body
5. Vas deferens	Of wolffian duct

OVARY

1.	Pflueger's tubules	Of germinal epithelial origin
2.	Vasa recta or medullary rays	
3.	Rete ovarii	
4.	Kobelt's tubules of epoophoron	Of wolffian body
5.	Gaertner's duct	Of wolffian duct

If we trace the course of the germinal epithelium from its surface to the wolffian body, it could be represented as in diagram.

The first portion of the downgrowth represented by *a*, *b*, and *c* constitutes the medullary ray. The distal or cortical portion, *a*, atrophies easily and disappears completely. The second portion, *b*, becomes the normal graafian follicle. The third portion, *c*, atrophies more or less and may or may not be absorbed. From the lower portion of the rete several tubules finally merge into one which passes out of the ovary to unite with the glomeruli of the wolffian body.

To recapitulate: it has been shown through embryological studies that the ovary at some time in its development possesses a system of tubules, which have their exact homologues in the seminiferous tubules and excretory ducts of the testicle. Embryological studies have also shown that all the structures within the ovary, namely, Pflueger's tubules or cords, the medullary cords and the rete ovarii, to well outside the boundary line of the normal ovary, are of germinal epithelium origin; and it has been demonstrated that the tubules of the epoophoron, or of the wolffian body, do not penetrate into the ovary, but are met outside the ovary by the rete ovarii as it passes out of the hilus.

I now wish to take up other facts which have heretofore not been recognized and which offer incontrovertible arguments for the substantiation of the conclusions stated above.

In the first place, I have found so frequently immature ova within the whole length of the medullary cords, that there can be no doubt that they arose *in situ*. At a certain stage in the development of the ovary, it is not the exception to find this condition of affairs. Their presence is transitory and their life history is a short one. As we will see later on, this is the fate of thousands of these ova. They do not all perish.

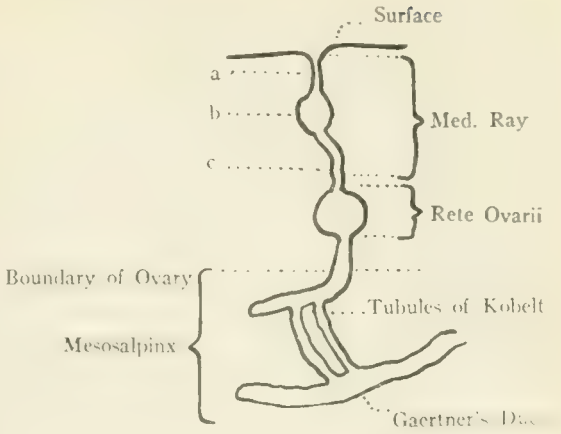

Diagram of development of the ovary.

Occasionally an ovum seems to escape. But it is a fact that where one ovum comes to maturity, a thousand are lost in the process. The same statements apply to the rete ovarii, though in a much more restricted sense. In all my specimens of embryos I have found about ten or twelve ova right in the center of the rete. Inasmuch as these very soon succumb to the general destruction, and as ova have no motive power of their own, and as the character of the tubules would preclude any possible motion being imparted to the ovum, we are forced to the conclusion that this again is incontrovertible evidence of development of ova from the lining both of the medullary cords and of the rete ovarii. Is it not also incontrovertible evidence that these structures are derived from the germinal epithelium, and have retained some of their powers which were impressed upon them in their primitive state? To the arguments of those who claim that both the medullary cords and the rete ovarii are derived from the epoophoron, I can only add further the statement that it seems quite inadmissible that nature would allow so important a function as oogenesis to be shared by two structures of totally different origin.

Have these fœtal rests any functions? Without the slightest hesitation one can say that in the human ovary they have no normal function. There cannot be the slightest doubt but that the only normal function they could perform would be the function of

oogenesis. But we know equally well that the formation of ova is a function of division and differentiation which in the human species takes place exclusively during fœtal life and the first two years of postnatal life. Scientific opinion upon this point is quite unanimous. But there is not the same unanimity when it comes to the question of the other mammals. In the lowest members of this order, I think it is generally admitted, oogenesis goes on, not only in fœtal and early postnatal years, but throughout the whole of the sexual life. I, myself, am convinced that ova are developed in the bitch throughout her whole life, and in the case of the cow at particular periods. If such is the case, from what do these ova originate? From a careful study of the bitch's ovary, the different types of tissue which I have described above as being found in the medullary tubes are but different stages in the develop ment of ova. In the second type, where the tissue presents much the character of syncytial cells with vacuoles, it is but the beginning of that development which eventuates in the formation of ova. I am convinced that this goes on throughout at least the sexual life of the bitch, and that ovulation by its stimulating influence, or by the consequent mere increase of vascularity awakens these oogenitic factors temporarily into activity. I have found ova in all stages of formation. In the vast majority of these developments the ova are quite imperfect and are doomed to a short life. Hundreds of them in one section may be seen as the mere phantoms of ova. If the ovule has developed but slightly (it will have developed a vitelline membrane early in its career) and then succumbs, it will be found with its vitelline membrane somewhat distorted and surrounded by a mass of follicular cells of deeply staining syncytioid characters. If development has gone on further before retrogressive changes set in, the syncytioid cells lose that character and take on the character of the first type as described above, that is, the ovum, composed now usually only of a vitelline membrane filled with degenerative droplets, is surrounded by a layer of tall, delicate, slender, filamentous cells which stain poorly. This is the prototype of the zona radiata of the discus proligerus.

These facts taken singly or together cannot leave any doubt as to the germinal origin of all the tubular and solid epithelial structures found in the subcortical and central zones and hilus of the human ovary. For if such is the case with the higher vertebrates, we cannot but believe that the process is the same in the human species. It seems quite impossible that two tissues so widely different as germinal epithelium on the one hand, and wolffian ducts on the other, should possess such high potentialities and specialization as are required to develop ova and their necessary adjuncts. True, if we go back far enough, both germinal epithelium and wolffian ducts were derived from the same cells of the cœlomic cavity. But with that type of argument we need go back but a little further to realize that all tissues of the body have common parents in an ovum and a spermatozoon.

The atrophy of structures so far described refers only to those superfluous tissues of fœtal origin, but in the dog and in several other animals there takes place a second downgrowth of germinal epithelium into the cortex of the ovary. This usually takes place in adult life. The invasions are quite glandular in appearance, never contain ova and are fruitful sources of new-growth with lower animals. Whether such a second invasion takes place in the human has never been determined.

In reference to this second invasion of the cortical zone by the germinal epithelium in postnatal or adult life in some animals Winiwater states: "An important fact remains, we never find in this glandular invasion nuclear elements so characteristically found in germinal cells on their way to become ova. So far as my experience goes this late invasion does not produce ova."

I am convinced that these late characteristic invaginations of the germinal epithelium, at an age when the animal has reached, or almost reached, full development, offer a ready explanation for that strong tendency in the human ovary for the germinal epithelium when invaginated by any of the

causes which will be mentioned later, to burrow and invade deeply and give rise to a typical growth. Waldeyer vaguely gave expression to the same opinion when he stated that this new formation of tubules from the germinal layer in some of the lower animals was but an expression of an inherited tendency in these cells.

THE INTERSTITIAL CELLS OF THE OVARY

In order to avoid confusion, it may be well to state that according to recently accepted views there are two distinct types of cells in the stroma of the ovary. It will not do to speak of them in common as interstitial cells, or as stroma cells, or as connective-tissue cells, because they have distinct separate origins which bind the one on the one hand to the epithelial group, and the other to the connective or fibrous tissue group. The former is of mesothelial, the latter of mesoblastic origin. However, *faute de mieux*, the term interstitial cells has passed into common usage, and as a means of distinction the mesoblastic tissue is known as the connective tissue or supporting tissue, or stroma.

Since Linion's and V. Winiwater's articles, an almost infinite number of works have appeared, culminating in Miss Lane Clappon's and Miss McIlroy's epoch-making article. With a lucidity that deserves the highest praise they have shown that there are two distinct cells in the ovary, the interstitial cell allied to and originating from the germinal epithelium and the connective-tissue cell proper derived from the connective tissue of the wolffian body. The former, therefore, possesses much of the potentiality of the oogenic tissue, the latter is but a supporting structure. My work upon the human ovary tends in every respect to confirm their work upon the mammalian organ. My specimens fortunately contain three of exceptional importance in this connection. Two of them are from the human ovary, one of a fœtus of about 7½ or 8 months, the other a child which died suddenly immediately after birth owing to a diaphragmatic hernia. In each of these specimens, whether due to some peculiarity in the stain, or whether due to the phase of development of these structures, each interstitial cell is so clearly defined and so beautifully stained that it offers the greatest contrast to the slender fibrillar intervening connective tissue. Their origin from the germinal epithelium stands out most clearly, and their differentiation from the follicular cells is as yet not complete. The limit of invasion of these cells in the ovarian tissue is clean-cut, and here again offers the most marked contrast to the faintly-pink-stained connective tissue.

The third specimen is from a rabbit, which had its back broken twenty-four hours before parturition by being clumsily lifted by the neck by one of the orderlies. Immediately paralysis of the hind legs and rear portion of the body set in. Parturition set in next morning, and the rabbit died in the second stage of labor without being able to expel the fœtus. The ovaries in this case were cut. They are from pole to pole just one mass of lutein cells. The outline of the true corpora lutea is well marked by a delicate band of fibrous tissue. Between them and all about them right down to the depths of the hilus, similar cells fill the whole field. Every interstitial cell in the ovary seems to have been converted into a large oval or polygonal cell resembling in every particular but one, the true lutein cells of the corpora lutea. That one and only distinction consists in a slightly smaller size of the extracorpus cells. Most minute examination with the highest powers of magnification reveals no other differences. The fine strands of fibrous tissue that interlace with these cells are readily seen. With Sudan III the whole ovary seems a mass of fat.

There can be no doubt that the ovary contains two types of cells, the interstitial and the connective tissue; the former, derivatives of the germinal epithelium and capable of transformation of form and endowed with secretory function; the latter merely supporting structure in the strictest sense of the term.

II. THE ORIGIN OF EPITHELIAL NEW-GROWTHS OF THE OVARY

The work in the preceding pages has led to a generalization the bearing of which is far-reaching, namely that all epithelial struc-

tures within the ovary are derived from a common source—the germinal epithelium.

Division and differentiation has led to wide differences in form and function. But we have seen that the characters—the primitive characters—of this epithelium may make themselves manifest when the proper stimulus comes, and we have seen how imperfectly that assumed function may be performed. This assumption of power is capable only by virtue of the inherited susceptibilities of these cells which are among the oldest in the animal kingdom. With this knowledge afforded by comparative and human embryology, the subsequent discussions will be greatly facilitated.

It would seem at first sight as if we stood today just where we were twelve years ago, as regards the histogenesis of simple and malignant tumors of the ovary. The various classifications which have been given have not as a rule been histogenetic, but rather, topical, clinical or histological.

Under such systems, the varieties become as a rule (except perhaps the first) so numerous that the subdivision becomes cumbersome. Clinical divisions and pathological subdivisions of any general system have become almost a necessity, but the wholesale multiplication of varieties has much in it that deserves condemnation.

I have tried to give a histogenetic subdivision which sacrifices nothing to brevity.

A. Tumors arising from the germinal epithelium { Ovulary. / Non ovulary.
B. Tumors arising from the stroma.
C. Tumors due to cell inclusions.

"It would be very fine," writes Pfannenstiel, "if when studying each tumor separately, we could place it in its proper histogenetic category." I quite agree with Stratz, that a subdivision of tumors into cystic and solid, is not only unscientific but also impracticable, for neither clinically nor anatomically do tumors allow themselves to be placed in either one of these classes.

What are the structures in the ovary from which epithelial tumors may arise? They are germinal epithelium, follicular epithelium, ova, medullary cords, rete ovarii, corpora lutea, corpora atretica and the interstitial cells. If we include also inclusion tumors, we have covered the whole of the tissues from which they can take origin. But if we ask, can tumors arise from each of these? then the matter becomes one in which you form your own conclusions, either from mere preponderance of opinion or from your own observations. However, it seems advisable to deal with the subject from the view-point of these fixed and known tissues, rather than to take up each class of tumor and try to work back to its origin.

TUMORS ARISING FROM THE GRAAFIAN FOLLICLES

Wendeler very aptly remarks that it was natural, owing to the cystic formation of most tumors, to suppose that they were derived from follicles.

Can the epithelial lining of the graafian follicle give rise to tumors? In the first place, a distinction must be drawn between the membrana granulosa of a developing graafian follicle and the single layer of partially developed epithelium which surrounds a primordial ovum in the quiescent state.

If we exclude the condition which is commonly known as "hydrops folliculi," I can say with every emphasis, that I do not believe that tumors can arise from the graafian follicle in process of development or degeneration. For years the pathological material from several hospitals, both abroad and at home, has been examined with this end in view, and the result of my observations cannot be expressed in other terms. The varieties of degeneration of the membrana granulosa before or after the death of the ovum are few. The process is singularly simple, and it has never fallen to my lot to see these cells take on characters such as would justify one in assuming that they form the lining of a true cyst.

Are we to classify as tumors the condition known as "hydrops folliculi"? It seems to me that it is a misapplication of a term. Is it even a pathological state? It has happened so often that the small cystic ovary, or fibro-

cystic ovary so called, has yielded under the microscope a prolificity of graafian follicles that is striking. So often is this the case that one grows skeptical of these terms. A careful examination of true cases of hydrops folliculi shows that neither the ovum nor the membrana granulosa have suffered any appreciable change and I am firmly convinced that the great majority of these ova mature or are cast off by premature rupture of the follicle. In none of these follicles does one find the fatty degeneration or secretion in the tunica interna—a condition which forecasts death of the ovum.

Pfannenstiel says they are usually single and one-chambered, i.e., they do not build daughter cysts. Why would they be single if such cysts were of graafian follicle origin? One would imagine them multiple by the very fact of their origin. Olshausen says when they are multiple, which is seldom, the number is usually small. Most textbooks state that the cysts lie side by side and do not communicate, and the one does not develop out of the other. These arguments seem to have been transcended from textbook to textbook. These two statements so simple in appearance would be among the very hardest possible to prove.

Another arbitrary division is found very frequently, namely, that these cysts are always of limited size; for some the fist, for others the fœtal head is the limit. If they exceed this size, they pass into another category. This seems the most arbitrary of arbitrary divisions. Now it is a singular thing that in the many ovaries that have been examined in the past four years from all the species of animals mentioned in the foregoing pages, never has there been a tumor found arising from the graafian follicles. Hydrops folliculi has been found frequently, but the membrana granulosa was intact. When this had been discharged and had mixed with the liquor folliculi, the cavity became merely a cavity lined by flattened cells of the tunica interna. The small cystic ovary of the dog and cat, and many other animals, has quite another origin, as will be described later.

No one will deny the clinical entity known as "hydrops folliculi," but the interpretation admits of more than one opinion. Nagel believes that these are nothing more or less than unusually large healthy graafian follicles, and I fully concur. We would hardly classify hydramnios as a new-growth, nor does the fœtus succumb even when the quantity of fluid is exceptionally great. Why then should the ovum be doomed under somewhat similar circumstances? The fact remains that hydrops folliculi, when it exists, is nearly always multiple, oftentimes classified clinically as the small cystic ovary, yet according to textbooks, the tumor to which hydrops folliculi is supposed to give origin is in the vast majority of cases single, not multiple.

To my mind there is not one case in the literature of a graafian follicle that is supposed to show developing papilloma, that will stand the test of a scientific criticism. Nagel holds, and I think with perfect justice, that the transformation of the membrana granulosa into a cyst epithelium owing to the death of the eggs, is an impossibility.

In many of the animals in which large and small cysts abound, there are many that can with the greatest ease be traced to their origin, and the same applies to my specimens of human ovaries. Yet in not one of these is there any evidence that cysts, as new-growths, have arisen from graafian follicles. It may be objected that the fact that they have not been found in these series is not proof positive that they do not occur. The whole question seems to resolve itself into this: Are we to consider "hydrops folliculi" as a type of new-growth, or as the product of local change? The question is very difficult. That hydrops folliculi as a clinical entity does exist, no one will deny, but that it can reach anything like large dimensions, I think few will be prepared to admit. Through the work of Kroemer we know that the association of cysts of the ovary with chorioepithelioma of the uterus is quite a common one. We also know that in the ovaries of a pregnant woman, especially if she is somewhat advanced in her pregnancy, we find not only a large corpus luteum of pregnancy, but the other graafian follicles which contain ova in process of maturation develop a thick layer of lutein cells in their theca interna.

It is as though the fœtal metabolism demanded greater lutein secretion and the theca of these incompletely developed follicles were called on prematurely to do their share of the work. This is the usual course of events as it has been worked out by Seitz and myself.

Such follicles, as Limon has pointed out, the theca interna of which has undergone, or is undergoing this lutein change, have doomed the ova that they contain to destruction.

Chorio-epithelioma acting in a sense like a pregnancy and being derived from a pregnancy, causes all the changes in the ovary that are usually found in a normal pregnancy only to a much greater degree. The ovary becomes markedly cystic and often of considerable volume. If we examine these cysts, we find that they are mostly, if not all, developed from the corpus lutein of pregnancy and from the graafian follicles which were maturing when the abnormal impulse overtook them. The truth of the statement lies in the fact that if these cysts are examined in the early stage they are surrounded by layers of lutein cells just as are those graafian follicles in partial maturation during pregnancy. An impulse to cyst formation seems to sweep over the ovaries in cases of chorio-epithelioma. These are true graafian follicle cysts and not infrequently reach considerable size. Yet, and this is the interesting fact, the large cysts are all devoid of an epithelial lining, being covered either with blood, or serum, or fibrin, or a layer of lutein cells, and only in the smallest can remains of the membrana granulosa be found.

It is very apparent from such cases that a transformation of the lining epithelium of a graafian follicle into the usual lining of a new-growth is an impossibility; that after the death of the ovum the membrana granulosa—a membrane of highly specialized function—has no longer a *raison d'être* and slowly liquefies. If such were not the case, why would not the larger cysts in chorio-epitheliomatous cases still be lined by a membrana granulosa transformed into a one or two layered epithelium?

THE FOLLICULAR CELLS OF THE PRIMORDIAL CELL NESTS

Do epithelial tumors arise from these cells? Theoretically these cells are so closely allied to the germinal epithelium, they have undergone so little differentiation, that there is no apparent reason why theoretically they should not give rise to new-growths. Yet practically such has never been satisfactorily demonstrated. Many authors have published reports of cases in which tumors have been described as having arisen from this structure. The question is a most difficult one to decide, and after all it is a matter of small importance as it will be shown later that these tumors arise either from this primordial follicular epithelium or from invaginations of the germinal epithelium.

Tumors arising out of the follicle cells of primordial follicles have been described by Gottschalk, Steffeck, Bulins, Pozzi and Beausseriat, Pfannenstiel, von Velets, von Kahlden, Hofmeier, Franque and Limnell, none of which, however, seem conclusive, except perhaps that of Gottschalk. Most of the others, as Waldeyer and Heinrichs state, offer other explanations that are much more readily acceptable.

As stated above, even in the bitch where there is normally an invasion of the superficial layer of the ovary by small ducts, which practically never contain normal ova, it is impossible to say under such circumstances whether a tumor arising in this neighborhood, originated in one of these small downgrowths or in a real primordial follicle, and so it is in the human ovum. Small cysts in the immediate neighborhood of the surface epithelium, may so mimic the epithelium of the primordial follicle, that it would be quite impossible to state even at this early stage with any degree of assurance that it arose from the one or the other of these two sources.

THE ORIGIN OF EPITHELIAL TUMORS FROM THE GERMINAL EPITHELIUM

Nothing in the human body can equal the metaplastic power of the germinal epithelium. When we stop to realize that all the epithelial tumors of the ovary (except those few which are classified as inclusion

tumors) are derived from this epithelium either directly or indirectly through the medium of structures to which it primarily gave rise, we are struck with the latent power of these cells when they are awakened into activity. When we realize that such widely different cells as the apparently simple interstitial cells of the ovary at one end of the list, lead, through many mutations, through the follicular epithelium, membrana granulosa, ciliated epithelium mucous cells to the most highly specialized cell—the ovum—we do cease to wonder at the multiplicity of varieties found among the ovarian new-growths.

We have seen in the first half of this monograph, how by a study of comparative anatomy the whole problem of development and atrophy in the human ovary has taken on a new aspect. In that part of the work, I stated that the amount of atrophy of epithelial structures in the late months of fœtal life and early postnatal life varied greatly not only between different species but between different members of the same species. As examples I quoted that the difference between the bitch's and the sheep's ovaries in the matter of the amount of apparently functionless structures retained was very great, but that there were also great differences between any two bitches' or any two of any other species. So it is with the human ovary. In some, even in serial sections, I have found not a trace of any fœtal rests except a small rete ovarii. In others, on the other hand, it is impossible to examine any one preparation without finding not only traces but long stretches of fœtal remnants. This applies equally to ovaries of all ages. What the percentage of cases would be in which such structures are found cannot be stated except by serial sections of a very large number of ovaries at the early adult life. This I have not done, but judging from the frequency with which these structures are found in the ovary before puberty, that is before the ovary is scarred by the rupture of large graafian follicles, the percentage of cases in which fœtal rests occur must be inordinately high—very much above the figures given by Schickele.

These remnants usually lie deep down in the medulla of the ovary, often in the neighborhood of the rete ovarii. At times they are in the form of tubules with well preserved epithelium, at other times the epithelium has remained arrested in a state of partial atrophy. Not infrequently there is a cavity, more frequently they are solid. Often the remains run off from the rete, merely resembling dark lymph spaces. Toward the surface of the ovary one recognizes these fœtal remnants in the deep crevices or lobulations of the surface of the organ, or by the presence of solid columns of cells, or real ducts which communicate with the surface. If these latter occur before fœtal life, yes even before full adolescence, they are undoubtedly of fœtal origin, for none of the causes which could give rise to such sinkings have as yet begun to operate.

There are other fœtal remnants that require description. One frequently finds in human ovaries of all ages certain sectors of the ovary which stand out in marked contrast to the remaining portion of the ovary. Some of these cases will be described. The segment so characteristically changed presents all the appearances of having been arrested in its development, whereby the fœtal structures which should have been absorbed have crystallized and the further development of the segment has not taken place. It is, therefore, a segment which has remained fixed in a stage of imperfect development. A close survey of these cases nearly always leads to a vascular defect as an underlying cause. They present an appearance not unlike what might be the late stage of an infarct. The incidence of these cases in those that have come under my observation shows conclusively that this is a common defect. Let me describe some notable cases:

Case 1. A fœtus which died at full term. The right ovary normal. The left ovary is normal except for a segment about the middle with apex to the medulla. The surface of the ovary at this spot circular and about 1 centimeter in diameter, is whiter and of firmer consistence. On macroscopic section no change visible except pin-head cavities. Microscopically, a wedge-shaped portion of the ovary, well defined, is devoid of normal ova or its adjuncts. Instead the segment is full of glandular or epithelial elements, some of which are typically

glandular, others are solid columns which at times degenerate into mere lymph-like spaces. The picture is undoubtedly one of arrested atrophy. Other portions of the ovary are quite normal.

Case 2. A child of one year. Right ovary normal; left ovary contains a segment in the inner pole very similar to that described above. The rest of the ovary is normal.

Case 3. Girl of 14 years of age. Left ovary normal; right ovary contains at inner pole a wedge of tissue in arrested development. This wedge is filled with epithelial elements and glands. These are frequently broken into short segments. The limits of this wedge are abrupt as if due to an infarct. In many sections the glands contain goblet cells and ciliated epithelium (?).

Case 4. In this case of a young child of 2 years an irregular segment of the right ovary seems to have suffered a blight. All about this area the normal structures are found whereas in this area which from its outline gives one the impression that it is due to some vascular disturbance arrest of development has taken place. The arborescent fœtal structures are lined with cells that stain a deep blue in marked contrast to the pink and blue of the normal tissues.

I think that such a condition whatever its cause offers an explanation for those rare cases where the ovary remains in its fœtal state, disseminated with canals lined by germinal epithelium, a total absence of ova, a generalized firm fibrous consistence, and a proneness to develop multiple cysts. Frommel (?) has published such a case, and one came under my observation some years ago, when working in the laboratories of the Pathological Institute of Freiburg, in Professor Aschoff's service. Quite recently, a second case, somewhat similar came into my possession. This ovary differing somewhat from any heretofore described, throws so much light upon the origin of tumors that it will repay a thorough study.

It was removed from a young woman of 23 years, married 3½ years, no children. Menstruation late in onset had always been scanty. Uterine dysmenorrhœa was not a marked feature. The external genitals were healthy. Owing to severe left-sided pain of a burning character, which gave all the indications of being due to sigmoidal trouble, but which resisted all forms of palliative treatment, an exploratory laparotomy was done. The sigmoid presented nothing pathological on its peritoneal surface.

The left ovary was slightly, very slightly enlarged, but was hard, and almost cartilaginous in consistence. A few small cysts were visible upon the surface. It was deemed advisable to remove this as being possibly a contributing cause.

Microscopically in none of the sections is there an ovum, either in the quiescent or maturing state. The surface epithelium is unusually tall and columnar. In one of the creases of the surface doubtful cilia are visible. The fibrous stroma is unusually dense and hyaline. The whole ovary is disseminated with small cysts which by their general arrangement run in lines from the surface toward the center of the ovary. Many of these communicated with the surface epithelium by a solid strand of cells. In others this was lacking, but by the course of the fibrous tissue, one could easily see that previously such a connection had existed. The cysts are particularly interesting owing to the variety of their epithelial linings, and the differences in the amount of vascularity of the surrounding fibrous tissue. There are small and large cysts (microscopically); cysts without any apparent epithelial lining, others with a flat lymph space-like covering; still others with cuboidal cells. In this cyst we see tall cylindrical cells, in that one goblet cells, and still further on, undoubted ciliated epithelium. In one of the larger cysts the wall has become very vascular and papillary ingrowths are quite frequent.

That this is an ovary arrested in its embryonic development, I think cannot be doubted. It presents all the features of such a condition. How such a condition can arise is indeed quite another problem. And yet I possess among my specimens two which I prize most highly. These were obtained during my work at the Friedrichsheim Krankenhaus in Berlin. The first was that of a child of five years which had died of chronic nephritis, secondary to scarlet fever. The one ovary was quite normal in every respect. The second was much smaller. The characters of the latter, the evident atrophy of the parenchyma, the shrinkage of the tissues, led me to examine the vessels in the hilus. These were unusually small and cross sections of the main trunks of the vessels farther out in the broad ligament and of the ovarian and uterine vessels of that side showed almost complete closure due either to a developmental defect or to an early obliterative endarteritis.

The second case was that of a girl of eighteen, who died of brain tumor of syphilitic origin. One ovary was perfectly healthy, ovulation had gone on, and there were slight remains of lutein cells and of corpora throughout the ovary. Microscopically this was a perfectly normal ovary. The other ovary was much smaller. The contrast under the micro-

scope could not be more marked. This ovary was like that from a woman of 50 years. The fibrous tissue was seemingly more adult in type. There were a few ova which had begun to mature. The most of these never reached an advanced state of development. The ovary therefore contained retention cavities, the results of these atrophic graafian follicles. But the most striking feature was the presence of many corpora candicantia, which are similar to those found in the aged who have not sufficient vitality totally to destroy and totally to absorb. This artery was also the seat of a chronic obliterating syphilitic endarteritis.

I have quoted this last case as showing the effect of faulty vascularization in the adult, and as throwing some light perhaps upon the previously described cases, which occurred during the developmental or embryonic state, when any change in the blood supply would lead to faulty destruction and absorption of redundant tissues.

Of course the only effect such change could have on the adult ovary would be to retard destruction and absorption of functional vessel scleroses and absorption of the products of corpora lutea and corpora atretica thereby causing such an ovary to resemble that of an aged woman.

Pfannenstiel has described cases in which the surface epithelium bore patches of ciliated epithelium. Some of these ovaries were quite normal. Others were the seat of tumor growths. Desinety also found islands of ciliated epithelium upon the surface of otherwise normal ovaries. Waldeyer found it in six different cases, in five of which there was cystic formation, and the sixth was the seat of chronic inflammation. Marchand to explain its presence upon the surface of the ovary, stated that it arose from the fimbria ovarica, and became detached from it. Williams, Walthard, and Kuszman, as previously stated, claimed also that these were isolated portions of the muellerian duct. In one of my specimens, there are islands of ciliated epithelium in a depression on the surface of the ovary.

Today it is fully recognized that there is a close relationship between the germinal epithelium and ciliated epithelium, and that the transition from the one type to the other is frequent and easy, and seems but the expression of a character which germinal epithelium once permanently possessed. Pick has drawn attention to the general tendency of the whole of the pelvic peritoneal surface to develop cilia.

In addition to the foregoing cases, which so far as it is possible to ascertain, date back their origin to fœtal life, there are other characteristic invasions of the ovarian stroma by the germinal epithelium, which leave no doubt but that they are acquired conditions, due to age changes and to inflammatory changes. Inflammation of the pelvic peritoneum giving rise to chronic perioophoritis, is a fruitful source of cyst formation. Clinical experience teaches, I think, that new-growths are not commonly associated or secondary to inflammatory changes. These inflammatory cysts usually subside with the subsidence of the inflammation. One can readily conceive that inflammation about an ovary containing many fœtal remnants may act as the stimulus that starts these into activity. In such cases the inflammation would therefore be merely an accidental association.

TUMORS ARISING FROM OVULES

The dermoids and teratomata. This constitutes perhaps the most interesting chapter of all those dealing with the subject of tumor formations in the ovary, and of late so much has been added to our knowledge concerning their origin, that today there is but little doubt that the ovules by a system of pathenogenesis are responsible for the presence of dermoids and teratomata. The evolution of this idea is interesting and facts that really bear upon the subject are indeed of but very recent date. Previous to this the whole subject lay in the domain of theory, and there are none that are more productive of controversy than just such.

The earliest theory held that teratomata and dermoids were of the nature of mixed tumors, arising from fœtal rests of already differentiated cells in the ovary. It also held that these were not normally developed in the ovary, but were due to a misplacement from other organs. Of late, this theory was again brought to light by Bandler who contended not only that this theory was well founded, but that the pronephros and the

wolffian body were responsible for these inclusions. In the light of our present knowledge, we know that not only the theory is wrong, but also that there was a misinterpretation of the facts from which the theory was developed.

Later Wilms pointed out by a careful examination of dermoids and teratomata, that the former were not the simple mixed tumors as generally held, but that they were mixed in the sense that they might contain structures developed from all the three primitive layers of the fœtus, but that the ectodermic layer or ectoblast usually was so predominately developed as to mask the other two, whereas in teratomata, it was usually the mesoblast which gained the ascendency. In other words, both these tumor types were really of only one kind for they both contained products of the three fœtal germinal layers, namely, the ectoblast, mesoblast, and endoblast. The difference, therefore, was one of relative quantities of these and not of quality.

But of late, as if stimulated by the warmth of the discussion between these two contending camps, the subject of parthenogenesis has attracted a great deal of earnest work. Within the last twelve years we find Delage and Bataillon busy over this subject in France. Loeb, Wolfsohn, Morgan and Weir in America, and later there are added Wedekind, Daudin, Arbacia and Kostanechi. The sum and substance of their work has led to a great deal of weight being added to Pfannenstiel's theory. Through the experimental work of these, it has been established beyond a doubt that parthenogenesis can be provoked experimentally, in echinoderms, worms, molluscs, anthropodes, fish and amphibians. Natural parthenogenesis has also been observed in mammals by Bischoff and Hensen, in batraciens by Bischoff, Leuckart, Born and Dehner, and in fish, worms, anthropodes, echinoderms and molluscs by a number of authors.

Lecaillon who has done a great deal of work upon this subject states: "We can consider as proved beyond all possibility of doubt that parthenogenesis really takes place naturally in many animals that are of widely different species. Parthenogenesis is really evoked by this fact, and this fact alone, that the unfertilized ovum is endowed with the ability and property to evolve along the lines of embryonic development of segmentation and differentiation, and not because the egg has encountered special stimulus and special surroundings. This is proved by the fact that in birds the segmentation of non-impregnated ovum takes place as the egg passes along the oviduct. Such segmentation therefore takes place under the same circumstances and surroundings as it does with the impregnated ovum which segments normally.

Pfannenstiel had stated that no dermoid or teratoma has been found sufficiently early to enable an opinion upon its origin. That was reserved for Loeb.

One year later the author found that parthenogenesis is a common occurrence in the guinea-pig, and that the ovum is the starting point of this development. He found that parthenogenesis occurs in about 10 per cent of guinea-pigs before they are 6 months old. Later, the condition is much less frequent. When describing one of these cases he writes: "We see in each case a choriomic vesicle with trophoblast and plasmodia and syncytia penetrating into the neighboring tissue. There is also a structure present which is probably to be interpreted as the neural tube. As this type of growth occurs in the cortex of the ovary where follicles are normally seen, and are found within follicle-like cavities, they can be derived only from ova developing parthenogenetically. Fertilization can be excluded as the life history of some of these animals is known and precludes such interpretation. It is very probable that parthenogenetic change sets in soon after ovulation, the altered conditions in the ovaries at that time (variations in blood pressure, in intrafollicular pressure, changes in oxygen supply) supply the necessary stimulus.

The later stages of these developing embryo bear some resemblance to chorio-epitheliomata. These observations demonstrate that chorio-epitheliomata and teratoid tumors that are found in the ovaries are not derived from misplaced blastomeres, as Bon-

net and Marchand believed, but that the older view is correct according to which at least the teratoid tumors of the ovary are derived from parthenogenetically developed ova.

Loeb might have gone one step further and included the dermoids, for histogenetically they are the same as shown above.

As for those extragenital cases, there seems as yet no adequate scientific explanation forthcoming. Pfannenstiel maintains that those of the trunk and peritoneal cavity have the same origin as those of the ovary. The assumption is that they arise from ectopic ovarian tissue which we know is found not only throughout the pelvis, but throughout the abdominal cavity, and it is well-known that the seat of the vast majority of these extragenital dermoids and teratomata are localized in the pelvis. Nagel, Minot and Ribbert have found wandering ova throughout the genital abdominal cavity. "Grant such a wandering of ova," states Pfannenstiel, "then the propagation of derivative tumors allows of a very ready and easy explanation."

Do pseudomucinous cysts arise from teratomata and therefore from the ova?

The frequent association of this type of cyst with the teratomata is more than accidental. Yet we are struck with the frequency with which the dermoids are surrounded by other cysts whose origin is known to be from the germinal epithelium of the ovary. As stated above Landau, Hanan, Ribbert and Askanazy, contend that the pseudomucinous cyst, whether alone or in association with dermoids is part and parcel of the dermoid and the expression of the development of the intestinal portion of the teratoma or dermoid just as the teeth, brain and jaw, and hair, are the expression of its cephalic portion.

If we look into the question more closely, we find that not only do pseudomucinous cysts surround dermoids, but the incidence of simple serous cysts in association with dermoids is more than a casual association. It would seem that dermoids by their irritation and growth stimulate the surrounding tissues to activity. We have seen how the vast majority of human ovaries contain all the necessary epithelial rests or late invasions for the development of cysts and tumors. We have seen how these rests or invasions, derived as they are from the germinal epithelium, possess the wonderful metaplastic properties of this epithelium. We have even seen how in certain animals these rests can produce ova and pseudo-ova, none of which, however, perhaps ever reach maturity, and lastly I have shown how the germinal epithelium can and does transform itself into mucous cells that have all the characters of the lining cells of the pseudomucinous cyst.

I have found several of my cases of dermoids with mucin mixed with the sebaceous material. Microscopic section always shows in corroboration of the microscopic description that this is due not to a portion of the original wall of the dermoid being a mucous surface as you would expect to find if the pseudomucinous cyst were part and parcel of the dermoid, but in each case it was quite apparent that the surface covered with mucous cells had once been a cyst separate and apart, and had later been incorporated. This fact taken with the many stated in this chapter cannot but lead, I think, to the conviction that pseudomucinous cysts are not only ovulogenic but are also of germinal epithelium origin.

The interstitial cells of the ovary. Upon the subject of tumors arising from this tissue, nothing so far has appeared in the literature. Inasmuch as this monograph deals with epithelial tumors of the ovary, and since it has been shown that the interstitial cells of the ovary are of epithelial origin, this tissue must be taken into consideration as a possible factor in the production of epithelial tumors.

It is singular that in many of the so-called peritheliomata the tissues change almost imperceptibly into carcinomata on the one hand and into alveolar sarcomata on the other hand. Particularly is this true of peritheliomata of the mucous membrane of the intestine. More especially are such tumor-growths found in the appendix vermiformis. I have seen several such in which it was quite impossible to state whether the new-

growth was of the nature of a carcinoma, or of a perithelioma or of a sarcoma, for all three types existed in the same specimen. There is a striking fact in connection with the ovary. In our series of malignant diseases of the ovaries at the Royal Victoria Hospital—a series extending over ten years—peritheliomata are eight times more frequent than are the sarcomata. In fact sarcoma of the ovary is in my experience a rare tumor of the ovary. This observation is confirmed by reports from the literature.

In view of these facts, I think the theory quite justified, that inasmuch as peritheliomata occupy morphologically a position midway between carcinomata and sarcomata, its relative frequency in the ovary might readily be explained by assuming that it arises from the interstitial cells which occupy a position morphologically between the epithelial and connective-tissue cells. The incidence of peritheliomata of the ovary in the ratio of eight to one of sarcoma has something more in it than will be accounted for by the law of accidental occurrence. Such a preponderance of peritheliomata in the ovary is found in no other organ in the human body. In fact the ratio is usually eight sarcomata to one peritheliomata. To me it is quite doubtful whether such a cell as the interstitial cell, could completely abdicate its primitive characteristics and so deny its origin as to develop into a sarcoma. We must not look upon the interstitial cell as being of a nature of a connective-tissue cell. It has a much more exalted function. We have seen how periodically when in the neighborhood of maturing graafian follicles it can awaken into activity and assume secretory functions and serve very materially in the maintenance of equilibrium in the internal economy. Its position morphologically speaking between the connective tissue and the epithelial structures make it preeminently the tissue responsible for the great frequency of perithelioma in the ovary.

PUERPERAL INFECTION; A PLEA FOR EARLY OPERATION IN PELVIC SEPTIC PHLEBITIS

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GENERAL INTRODUCTION

OFTEN masquerading under strange titles, puerperal infection is fraught with much tragedy for humanity. In English speaking countries alone it claims at least 10,000 victims every year. This estimate is necessarily higher than that of official statistics, since in British communities the fatal issue is often ascribed to such diseases as appendicitis, peritonitis, enteric fever, while Professor Whitridge Williams states that in America the majority of deaths from puerperal infection are set down to other causes.

The erroneous causes of death so frequently alleged in puerperal infection may represent mistakes in diagnosis but are often due to the medical attendant realizing that a frank admission of puerperal infection may leave him open to the charge of having "left something behind," or of having been unclean in his work. There may be no foundation for such charges, all aseptic care having been used, and not a particle of placenta being retained; on the other hand, the most scrupulously careful examination may fail to discover whether a freshly delivered placenta is absolutely complete.

In order to appreciate the full significance of the foregoing statements, it will be necessary to make some reference to the disease which Virchow named *polypoid decidual endometritis*, and which I discussed at length in 1918 in the March number of Surgery Gynecology and Obstetrics.

POLYPOID DECIDUAL ENDOMETRITIS

In the majority of the hundreds of cases of puerperal infection admitted to the Perth Hospital I have found polypoid decidual endometritis, with or without adherent placenta; so that the commonly assumed rarity of this disease of the decidua would appear to lie not in its occurrence but in its recognition. In works on puerperal infection and on obstetrics excellent examples of the disease are figured as "hypertrophied decidua," "necrotic decidua," "roughened placental site," and so forth. As time goes on these misleading titles will doubtless give place to the correct one "polypoid decidual endometritis," as with Professor Sir Harry Allen's specimens in the Melbourne University.

Polypoid decidual endometritis was mentioned first by Virchow in 1861 in connection with a three months' abortion, in which he found polypoid outgrowths of the decidua suggestive of condylomata. Following on Virchow's single observation, others as Gusserow, Bulius, Strassmann, and Ahlfeld described odd cases in abortions. Later (1908) Frank Nyulasy, of Melbourne, showed that the disease is a relatively common (3 to 5 per cent) complication of pregnancy, and is not seldom met with after full-time labor, a fact of high importance, since, although the placenta may be expelled complete, the patient may nevertheless die of puerperal infection dependent on the polypoid decidua. He worked out a satisfactory minute pathology, symptomatology, and treatment, and proved that the great outstanding feature of the disease is that the involved decidua is signally vulnerable to infection.

According to Frank Nyulasy, polypoid decidual endometritis is an interstitial inflammation of the decidua and partly of the underlying muscle. Depending on the extent and distribution of the interstitial fibrous tissue, the affected decidua may take the form of tough polypoid or papillomatous outgrowths, or may be merely tough, thickened, and uneven. The disease is a common cause of abortion and of adherent placenta.

PELVIC SEPTIC PHLEBITIS

Frequency and clinical types. The majority of fatal cases of puerperal infection fundamentally associated with the interior

of the uterus have, in my experience, shown pelvic septic phlebitis. On this point Lea states that this complication is responsible for from 30 to 50 per cent of all deaths from puerperal infection. The importance, then, of any surgical measure calculated to diminish the mortality from pelvic septic phlebitis can hardly be overemphasized. But while accepting this view, the surgeon is often confronted with the difficulty of discovering definite indications for operation. In cases with recurring rigors, in which the thrombosed veins can be palpated, there need usually be little hesitation, and brilliant results have been achieved by excision or ligature of the infected veins in a limited number of cases described in the literature. Such clear-cut cases of thrombophlebitis are, I believe, the exception, and we more often have cases admitted to hospital in which there is merely a subinvoluted uterus, but without any discoverable extra-uterine lesion, and in which there may be no rigors. With the latter group this article is mainly concerned, as they are the cases which, hitherto at least, have only too often been the despair of the surgeon. In what follows I hope to indicate rational lines for their early recognition, with a view to prompt operation, since delay may mean death. The following case is an example of surgery having been invoked too late.

CASE—GROUP A; LATE OPERATION

This case was admitted several days after labor with the symptoms of puerperal septicæmia. Examination revealed a subinvoluted uterus and extensive polypoid decidual endometritis, with some adherent placenta. In spite of clearing out the uterus and other treatment, the patient continued to deteriorate. When at this time I left for a holiday no gross extra-uterine lesion could be palpated, and no rigors had occurred. On my return in about 7 weeks, the patient was in a grave condition, and having rigors daily. Enlarged tubes were now detected, and on at once opening the abdomen (May 20, 1917) extensively thrombosed spermatic veins and double pyosalpinx were found. The thrombosed veins were excised to as high a level as possible, and the appendages removed. Pus was present in the left vein. After operation there were no more rigors, but in spite of some temporary improvement, the patient died in 8 days.

Importance of early operation. The temporary improvement after excision of infected veins noted in cases such as the foregoing suggested that in sufficiently early interference might be found a key which would open the door to new surgical triumphs. I realized that a proportion of cases terminate in natural recovery, but I was satisfied also that the majority (Lea says 60 per cent) terminate in death. It seemed to me then that the surgeon's duty to operate early should be even more imperative than in appendicitis, in which most of the cases are very properly submitted to early operation, although the majority would not end fatally in the absence of surgical intervention.

Diagnosis. In a patient with puerperal infection fundamentally connected with the interior of the uterus, as is most commonly the case, the relative frequency of polypoid decidual endometritis as a complication of pregnancy, and the marked vulnerability of the involved decidua to infection should be clearly borne in mind. Subinvolution, which is always a feature of polypoid decidual endometritis, indicates urgent need for examination of the interior of the uterus. If polypoid decidua (and any adherent placenta) is removed in the early stage, when merely subinvolution is present without perhaps quick pulse, fever, hæmorrhage, or foul discharge, the patient is practically certain to recover; otherwise, by delay she may die of puerperal infection in spite of late removal of the polypoid decidua.

Let us assume that in a case of puerperal infection, the uterus is cleared of any polypoid decidua and of any adherent placenta, and that examination has failed to discover any gross extra-uterine lesion in the pelvis or elsewhere. Thence onward it becomes a question of intelligent after-treatment and careful observation, the pulse respirations and temperature being taken every 2 hours, and in graver cases every hour. It is only by such short-interval records that we can gauge the progress of the case with any real accuracy.

If after some days—and no more definite rule can at present be formulated—the patient continues to deteriorate from puerperal infection, the diagnosis of pelvic septic phlebitis becomes largely a matter of exclu-

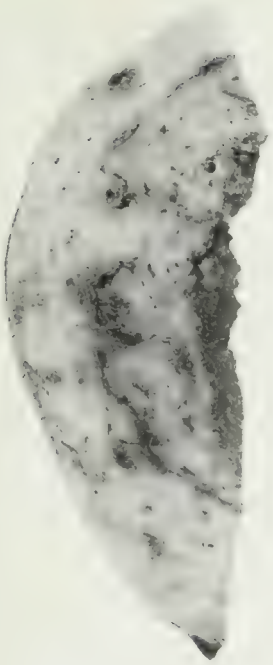

Fig. 1. Perth Hospital specimen: vertical section through uterus showing polypoid decidua. Patient admitted a week after labor with septicæmia, suppurative peritonitis, ovarian veins thrombosed, double pyosalpinx.

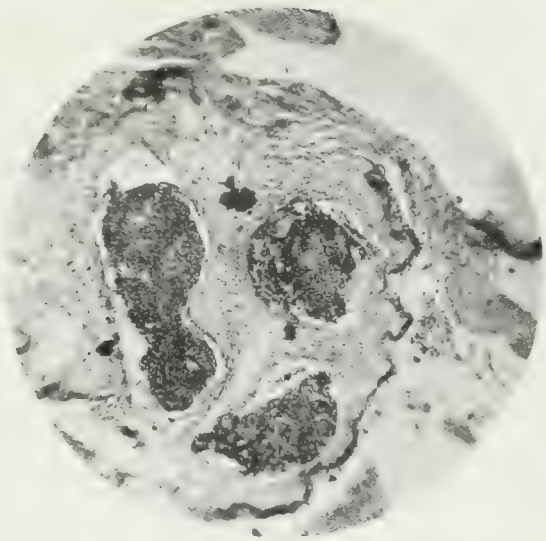

Fig. 2. Photomicrograph of section through polypoid decidua in Fig. 1, showing enormously dilated capillaries and interstitial fibrous tissue. Other sections showed marked endarteritis obliterans, but no glands discovered. Both sections and photos were made at Melbourne University through the courtesy of Prof. Sir Harry Allen.

sion. If no other pelvic lesion can be recognized, and no other septic focus (uterine or otherwise) can be discovered, we are, I think, generally justified in assuming the existence of pelvic septic phlebitis. The presence of localizing pain, or of rigors, or of femoral phlebitis would strengthen our diagnosis; the absence of these signs has no probative value either way. In the cases I have seen the thrombosed veins could not as a rule be palpated, so that in such circumstances the progressive deterioration is the only really safe indication to follow. Having then provisionally diagnosed thrombophlebitis, operation should be carried out without delay.

In cases such as that just outlined, might not the septic symptoms be dependent entirely on extensive and virulent infection of the uterine substance? Assuming the uterus has been cleared out, the only sign that would definitely suggest the condition would be marked tenderness of the uterus to pressure. Infection of the uterus of so serious a character, without thrombophlebitis, has seldom come within my experience, although Henry Jellett successfully tied the ovarian veins in one such case, the supply of poison from the infected uterus being in this way shut off. In a similar case in which I tied the ovarian veins some years ago, the patient quickly died of acute œdema of the lungs caused by six pints of saline intravenously injected by a too zealous assistant.

If in infection of the uterine substance alone there was evidence on cœliotomy of the infectious process leading to perforation, as by areas of softening or actual solution of continuity, hysterectomy with wide excision of the ovarian veins should be carried out.

The operations performed for thrombophlebitis are most commonly excision of the ovarian veins, and less frequently ligature of the internal iliac. In very extensive thrombosis the common iliac has been successfully tied, and Warneckros suggests ligature even of the inferior vena cava.

The case now to be described fairly well represents the practical application of the views herein enunciated. In five other cases,

pyosalpinx of greater or lesser degree was present with thrombosis of the ovarian veins, four of these cases recovering by operation.

CASE—GROUP B; EARLY OPERATION

A woman, aged 26, was sent in for "appendicitis" about ten days after labor in a public maternity hospital. She complained of pain in the right iliac region, but no tumor could be palpated, and the temperature chart made before admission was of a distinctly septic type. The pulse was 120, and the temperature raised, while the uterus was large and soft. There were no rigors before or subsequent to admission. Under anæsthesia much polypoid decidua was removed, only one very small particle of placenta being detected. The patient improved to such an extent that after a day or two her general condition ceased to give cause for serious anxiety while the iliac pain was relieved by local applications. At the end of about a fortnight, however, during the course of a day or two, she showed somewhat rapidly signs of marked deterioration, her color becoming bad, the pulse reaching 136, respirations 35, and temperature 103° F., while the iliac pain was again obtrusive. Up until this time the pulse had varied from 80 to 100, and the respirations and temperature were not much over the normal. No gross pathology could be palpated in the pelvis, the uterus was not tender, and no septic focus could be discovered elsewhere. On opening the abdomen (July 6, 1918) the right ovarian vein was found to be thrombosed, and adjacent intestines acutely inflamed and adherent; the uterine appendages were normal, while the appendix was healthy and almost entirely retrocæcal. The thrombosed vein was removed, and the abdomen closed without drainage. The pain very soon disappeared, the general condition quickly improved, with sharply falling pulse and respiration rates and the patient was discharged after a few weeks convalescence in the open air.

GENERAL CONCLUSIONS

The recovery of cases such as that just described encourages me to believe that early operation may save many cases of puerperal infection which would be lost when treated on the lines hitherto followed. Indeed, I have now come to consider it absolutely mandatory to open the abdomen in cases of puerperal infection, the moment there are the grounds, which I have indicated, for the diagnosis of pelvic septic phlebitis, and apart from any gross pelvic lesions discoverable by the known methods of physical diagnosis, and always assuming that the interior of the uterus has been cleared out. To me early operation in such cases has become a supreme duty.

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A UROLOGIC AND RADIOGRAPHIC STUDY OF THE SAMAR TWINS

With a View to Surgical Separation of the Bodies

By H. W. PLAGGEMEYER, M.D., F.A.C.S., Detroit, Michigan; and J. H. SELBY, M.D., Washington

THE Samar twins, Lucio and Simplicio Godino, were studied by us, at the request of the Brooklyn Society for the Prevention of Cruelty to Children, with a view to their complete separation by surgical intervention and as to the extent of possible danger attending such procedure. To this end, a careful observation of their gastro-intestinal tracts through the medium of the X-ray was made, combined with a differential study of the urological tracts, with a consideration of the interrelation, if any, of their blood vascular systems. The work was done at the Walter Reed Hospital.

The results of our observations are briefly stated below. That we were unable to follow our original intention of observing blood changes and excretory phenomena following test meals, as well as of producing a complete set of bladder pictures, was due to the inherent difficulty of getting absolute co-operation on the part of the twins themselves. We deem ourselves extremely fortunate to be able to present the following data.

RADIOGRAPHIC FINDINGS (J. H. SELBY)

The combined fluoroscopic and stereoradiographic examination before and during a barium injection of the colon revealed the following:

1. There is no bony union between any portion of the twins

2. The coccyx of Lucio, the larger twin, is well developed, as compared with that of Simplicio, which is rudimentary in type.

3. Lucio presents a functionating anus, while Simplicio presents an imperforate rectum, represented by a dimple which barely admits the end of the little finger, and is about one-fourth of an inch deep.

Injection of the colon was difficult, in that it was shown that there was no synchronism between the peristaltic action of the two colons. The irritation of the anal sphincter caused by introduction of the enema nozzle was appreciated by Lucio but not by Simplicio. Lucio experienced a slight discomfort, as soon as the enema solution entered his rectum, while Simplicio was not aware of its presence until the solution was seen by the fluoroscope to pass across the mid line into his portion of the joined bowel. From that time on to the expiration of the 30 minutes required for the injection, first one twin and then the other complained of an impending bowel movement. This alternation in their desire for defæcation was an interesting phenomenon, as opposed to the stimulation of urination, which invariably was simultaneous. The bowel injection was finally accomplished so that we were enabled to distinguish the outlines of the anastomosis.

It was found that the colon anastomosis was roughly "H" shaped, the lower left prong of the "H" corresponding to the rectum of Lucio; the lower right prong of the "H" simulated a small diverticulum, projecting caudalward to within about 1 centimeter of the dimple. The upper left prong of the "H" corresponded to the sigmoid of Lucio, and the upper right prong to the sigmoid of Simplicio, the cross bar representing the anastomosis.

At one time during the fluoroscopic observation, the solution was seen to ascend in the sigmoid of Simplicio while it was at a standstill in the sigmoid of Lucio. At this moment Lucio was complaining bitterly of his inability to retain the solution. At another time Lucio was remonstrating with Simplicio for complaining of his discomfort.

UROLOGICAL REPORT (H. W. PLAGGEMEYER)

An examination of the external genitalia of the twins, showed them *each* to possess a normal penis for the pre-puberal eleven-year-old male, with distinct and individual scrotal sacs, each boy having two descended testes, with epididymes and corpora within range of normal.

Fig. 1. The twins in normal standing position. Simplicio is slightly taller and stronger than Lucio. There is, however, a perfectly balanced reciprocal action in all their movements. They run up and down stairs, jump off chairs, etc., in perfect unison, and there is never any apparent indecision in their mutual co-ordination.

From the fact that urination was simultaneous through both urethræ, it was thought the twins might be possessed of a common bladder, and possibly of a common system of kidneys and ureters. To this end I resorted to the following simple method of differentiation.

Renal function. Phenolsulphonephthalein was used. Intravenous injection was not resorted to, owing to most strenuous objections on the part of the twins, and it was with difficulty they were induced to accept the deltoid intramuscular approach. As actual percentages were not desired this was considered satisfactory. Both twins flatly objected to catheterization, even with a No. 8 ureteral catheter, but, as it happened, this also was not necessary.

First day, May 19, 1919: They were each given at 3:30 p.m. 500 cubic centimeters of water to drink, with the following results:

Lucio, injected right deltoid 6 milligrams phenolsulphonephthalein. Injection 4:00 p.m.

		Lucio	Simplicio
Urination (simultaneous):	4:05 p. m.	No dye	No dye
	4:08 p. m.	No dye	No dye
First half hour	4:10 p. m	Dye present	No dye
	4:11 p. m.	Dye present	No dye
	4:15 p. m.	Dye present	No dye
	4:16 p. m.	Dye present	No dye
	4:18 p. m.	Dye present	No dye
	4:21 p. m.	Dye present	No dye
	4:23 p. m.	Dye present	No dye
	4:29 p. m.	Dye present	No dye
	4:31 p. m.	Dye present	No dye
	4:34 p. m.	Dye present	No dye
	4:36 p. m.	Dye present	No dye
	4:39 p. m.	Dye present	No dye
	4:40 p. m.	Dye present	No dye

Total 30 minutes:
Lucio, 250 cubic centimeters; 23 per cent phenolsulphonephthalein; specific gravity, 1,006.
Simplicio, 210 cubic centimeters; 0 per cent phenolsulphonephthalein; specific gravity, 1,006.

		Lucio	Simplicio
Second half hour	4:40 p. m.	Dye present	No dye
	4:45 p. m.	Dye present	No dye
	4:50 p. m.	Dye present	No dye
	4:52 p. m.	Dye present	No dye
	4:55 p. m.	Dye present	No dye
	4:59 p. m.	Dye present	No dye
	5:01 p. m.	Dye present	No dye
	5:04 p. m.	Dye present	No dye
	5:07 p. m.	Dye present	No dye
	5:10 p. m.	Dye present	No dye

Total 30 minutes:
Lucio, 326 cubic centimeters; 18 per cent phenolsulphonephthalein; specific gravity, 1,007.
Simplicio, 325 cubic centimeters; 0 per cent phenolsulphonephthalein; specific gravity, 1,007.
Lucio, first 30 minutes: phenolsulphonephthalein, 23 per cent; fluid amount, 250 cubic centimeters. Second 30 minutes: 18 per cent; fluid amount, 326 cubic centimeters. Total, 41 per cent, 576 cubic centimeters.
Simplicio, first 30 minutes: phenolsulphonephthalein, 0 per cent; fluid amount, 210 cubic centimeters. Second 30 minutes: 0 per cent; fluid amount, 325 cubic centimeters. Total, 0 per cent, 535 cubic centimeters.

Simplicio was watched for 5 hours, and failed to show any trace of dye. That they might possibly be possessed of one bladder was therefore ruled out when the phenolsul phonephthalein tests were made.

Second day: Simplicio was used as host; 6 milligrams of phenolsulphonephthalein being injected into right deltoid. Both urines were negative to phenolsulphonephthalein before injection. Each was given 500 cubic centimeters of water by mouth at 2:00 p.m. May 20, 1919, Simplicio: injected right deltoid, 6 milligrams phenolsulphonephthalein 2:19 p.m. Appearance time, seven minutes. The day was very warm, excretion by skin more active, and urination not so frequent as on preceding day.

		Lucio	Simplicio
Urination (simultaneous)	2:22 p. m.	Negative	Negative
	2:26 p. m.	Negative	Dye appeared
	2:27 p. m.	Negative	Dye present
First half hour	2:45 p. m.	Negative	Dye present
	2:55 p. m.	Negative	Dye present
	2:59 p. m.	Negative	Dye present

Fig. 2. (at left). There is no evidence of spina bifida. The circumference of connection stalk is 14 inches.

Fig. 3. Lucio is throwing Simplicio in torque. In movements of this type he is usually the more prone to lift his brother, and Simplicio swings himself with ease, due to the rudimentary form of his coccyx.

		Lucio	Simplicio
First half hour volume		350 ccm.	230 ccm.
Function		0 per cent	30 per cent
Urination	3:05 p. m.	No dye	Dye present
Second half hour	3:15 p. m.	No dye	Dye present
	3:30 p. m.	No dye	Dye present
Second half hour volume		260 ccm.	180 ccm.
Function		0 per cent	19 per cent
Urination	3:42 p. m.	No dye	Dye present
Third half hour	3:51 p. m.	No dye	Dye present
	4:00 p. m.	No dye	Dye present
Third half hour volume		275 ccm	185 ccm.
Function		0 per cent	10 per cent
Urination	4:15 p. m.	No dye	Dye present
Fourth half hour	4:30 p. m.	No dye	Dye present
Fourth half hour volume		220 ccm.	205 ccm.
Function		0 per cent	6 per cent
Total two hours volume		830 ccm.	615 ccm.
Phenolsulphonephthalein		No dye 65 per cent 49+10	
Specific gravity		1.005	1.003

Third day, May 23, 1919: Methylene blue 5 grains given to Lucio by mouth at 12:40 p.m. At this time specific gravities were: Lucio, 1,009; Simplicio, 1,023. Lucio was given 500 cubic centimeters water by mouth at 12:40 p.m.

		Lucio	Simplicio
Urination	2:20 p. m.	Blue	Clear
	2:40 p. m.	Blue	Clear
	2:50 p. m.	Blue	Clear
	3:05 p. m.	Blue	Clear
	3:35 p. m.	Blue	Clear
	3:40 p. m.	Blue	Clear
	3:45 p. m.	Blue	Clear
	4:05 p. m.	Blue	Clear
	4:30 p. m.	Blue (1,005)	Tr. blue (1,024)

Lucio had been given copious water, Simplicio none. At 4:30 specific gravities were: Lucio, 1,005; Simplicio, 1,024. Amounts: Lucio, 655 cubic centimeters; Simplicio, 115 cubic centimeters.

Seventh day, May 27, 1919: Methylene blue given Simplicio, at 10:00 a.m. At 3:00 p.m. Simplicio very dark blue; specific gravity, 1,007; Lucio, pale blue; specific gravity, 1,015.

May 28, 1919: Lucio was given 10 grains methylene blue by mouth at 10:00 a. m. It appeared in the urine in 1 hour and 30 minutes in both, though Simplicio had been given no water. Specific gravity: Lucio, 1,013; Simplicio, 1,022.

SUMMARY OF UROLOGICAL FINDINGS

Phenolsulphonephthalein injected in deltoid of each boy alternately, fails to materialize in the other within five hours, the period of observation.

Methylene blue, 5 grains by mouth to each alternately as host appears in the other urine at varying periods following appearance in the host, but the concentration of the dye is always greater in the host, even, though, under forced hydration his specific gravity is absolutely and relatively lowered.

Specific gravities can be raised and lowered at will in each. When one is given water, and the other restrained, specific gravity in the latter remains apparently unaffected by absorption from lower intestine of host.

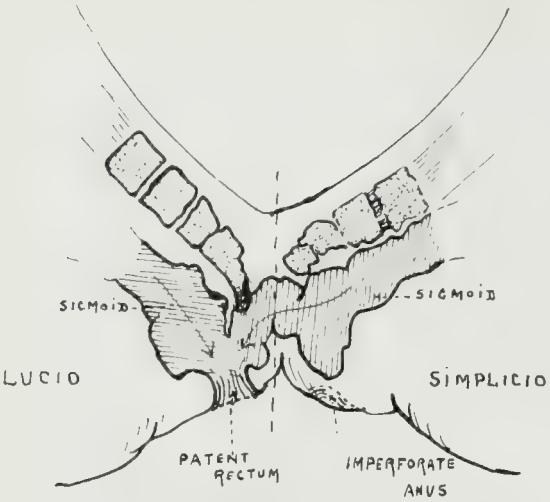

Fig. 4. Conventional diagram of roentgenogram. In the original plate the connecting arm between the two sigmoids is plainly seen, but the clarity of the sigmoidal outline is, unfortunately, lost in the print.

Both bloods are compatible, and classified under Type II (Moss classification).

It is evident from this brief study that the urinary tracts have nothing in common. The bladders and ureters are evidently distinct. The fact that they urinate simultaneously is partly psychic and partly due to the fact that the trigonal portions of the bladders are probably apposed, and the wave-like contractions in one bladder incident to distention stimulation cause muscular and fibrous contractions in one bladder, which reflexly set up a like action in the other. Then, too, there may be an interposition of fibers from the anterior branches of the nervi erigentes. This is doubtful.

The fact that phthalein does not go through, and that the pulse rate and blood pressure were at all times different, shows a lack of common blood circulation. The methylene blue apparently went through in the intrinsic vessels of the sigmoid. This is plausible from the picture in the radiographic plates.

We feel convinced from our observations on these boys, that they can be separated with relative ease, the chief difficulty to be encountered being centered in the attack on the sigmoids, and the correction of imperforate anus on one side. The urological tract should offer no difficulty.

As the boys are now eleven years old, and rapidly approaching the age of puberty, with its attendant changes in the pelvic blood supply, the present is the most auspicious time for surgical approach.

We wish to extend our thanks to Colonel W. L. Kellar, on whose service these observations were made, and to Lieutenant William D. Gill for his care in typing the bloods.

ACUTE OSTEOMYELITIS AND PERIOSTEITIS COMPLICATING EPIDEMIC INFLUENZA

Report of Five Cases; Radius Removed in One Case; a Review of the Literature of Excision of the Radius

By MOSES BEHREND, M.D., Philadelphia

In this small series of cases of acute osteomyelitis complicating epidemic influenza, three out of five cases occurred in children under ten years of age, the youngest being an infant one year old, the oldest a child of 9. As compared with some of the other complications of influenza, such as pneumonia and empyema, osteomyelitis plays a minor rôle. The period of onset of the symptoms of acute osteomyelitis, varies, the manifestations appearing weeks after the acute symptoms of influenza have subsided. In two of the cases an interval of 5 weeks elapsed before the symptoms of acute osteomyelitis appeared.

One fact has not been fully realized by the profession and that is that dangerous complications result if an acute osteomyelitis is not operated upon. The destruction of tissue and in some instances even the death of the patient, make it just as imperative that operation should be done in such cases as in cases of appendicitis and the measures used should be just as radical. The sooner the medullary canal is opened, the better will be the ultimate functional result. The only safe procedure is the removal of the entire roof of the bone (Fig. 1, Case 5). This insures adequate drainage, thereby enhancing the healing process which, as we all know, is a long process at best.

A search of the recent literature, up to and including January, 1919, discloses no reference to acute osteomyelitis as a complication of influenza. The cases reported in the early literature are few in number. Leclere saw a case of osteomyelitis of the maxilla following influenza. The patient had had an injury to this bone 5 years before. André makes no mention of osteomyelitis as a complication of influenza. Franke reports several cases in which periosteitis and osteomyelitis were found. Leichenstern has noted the existence of periosteitis and osteomyelitis of the tibia and fibula following influenza. He quotes Bose as mentioning a case of purulent osteitis of the tibia in a young man. In another reference Franke mentions a case of osteomyelitis of the sternum following influenza, in which syphilis could probably, but not absolutely, be ruled out. In the Surgeon General's Office, there is made mention of a case of osteomyelitis of the temporal bone as a sequel to influenza. Nichols, in his exhaustive study, makes no mention of osteomyelitis following influenza

The history of five cases follows:

Case 1. B. F., age 9. During the height of the epidemic of influenza, I was called in consultation to see the patient. At that time he had incisions on the forearm which had been made by V. A. Loeb. The history was that following an attack of influenza and pneumonia during which the child was very sick a swelling of the forearm appeared and spread rapidly. There seemed to be solution of the superficial fat. I advised then that the incisions on the arm be made larger to allow better drainage. About two weeks afterward, I was again called by Dr. Loeb to see the patient who then had a metastatic abscess around the left scapula. The child was removed to the Jewish Hospital where the abscess was opened and the sinuses of the arm were enlarged and curetted. After discharge from the hospital I did not see him until 9 weeks later when examination revealed an enormously swollen arm, with atrophy of the muscles of the arm and shoulder girdle. The forearm resembled a leg and there was practically no motion at the elbow-joint or the wrist-joint. The forearm could not be used because of the swelling and the excessive weight. Small quantities of pus were discharged from the sinuses. Diagnosis: acute osteomyelitis of the bones of the forearm.

A roentgenogram was taken and revealed an extensive osteomyelitis of the entire radius with a small focus of necrosis of the olecranon and the condyles of the humerus (Figs. 2 and 3).

Removal of the radius was then advised but before operating we consulted J. C. DaCosta, who agreed that all the dead bone should be removed. This was accordingly done. An incision was made the entire length of the forearm and on reaching the radius we found that the bone was lying in its

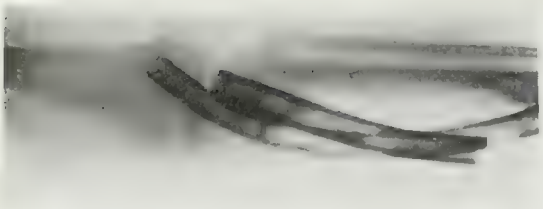

Fig. 1. Case 5. Note that the roof of the tibia has been removed.

bed practically as a huge sequestrum. It was easily removed. A small portion of the articulating surface of the radius including the lower epiphysis was left so as to prevent encroachment on the wrist-joint (Fig. 4).

At the present time the patient has an incurvation of the hand due to the removal of the radius; he has some supination and pronation and the elbow can be bent to an angle of 45 degrees. It was proposed at a later date to graft a piece of bone to prevent the inevitable deformity that must result from the removal of the radius, but this may not be necessary now on account of the regeneration of the radius which has since taken place (Fig. 5).

Case 2. Six weeks before the patient was seen in consultation with Dr. Applebach, he had suffered an attack of influenza. The mother states that one evening after supper the child suddenly complained about pain in the knee-joint and inability to walk. When I examined the child there was considerable swelling above the left knee-joint. A diagnosis of osteomyelitis of the femur was made. The patient was taken to the Jewish Hospital where an X-ray examination confirmed the diagnosis. An incision was made on both sides of the thigh above the condyles of the femur where pus was obtained. Through-and-through drainage was used. The child made an uneventful recovery, perfect healing and recovery taking place in 8 weeks (Fig. 6).

Case 3. A woman about 30 years old, with symptoms of influenza, was admitted to the Mt. Sinai Hospital on Dr. Shmookler's service. While in the hospital she developed swellings of both forearms and the right elbow-joint. These swellings were similar to those in Case 1, but the further progress of the case demonstrated that there was a periosteitis instead of a deep infection of bone. The swellings were incised and a large amount of pus was liberated. The wounds healed well.

The last two cases were fatal.

Case 4. H. L.; age 16. Several weeks before admission symptoms of influenza developed. The patient was extremely emaciated. He had symptoms indicating osteomyelitis of the lower end of the femur and this diagnosis was verified by X-ray examination (Fig. 7). At operation very little pus was found but the general toxæmia was so severe as to offset any benefit derived from the incision and drainage. An attempt was made to increase his

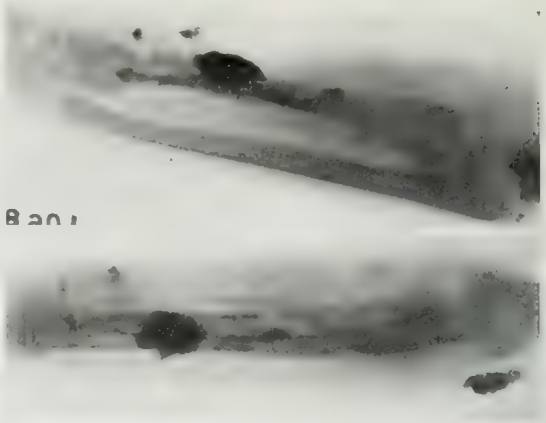

Fig. 2. (at top) Case 1. Necrosis of radius, bismuth injection. Anterior view.

Fig. 3. Case 1. Same as Figure 2, lateral view.

resistance by forced feeding and blood transfusion but to no avail.

Case 5. A baby one year old was admitted to the Mt. Sinai Hospital with symptoms of osteomyelitis of the tibia following influenza. This little patient was first operated upon in another hospital. An abscess was opened over the shaft of the tibia. X-ray examination disclosed a deep infection of the bone. The entire roof of the tibia was removed. The medullary cavity was exposed and from it exuded a large amount of pus. A few days afterward a large swelling appeared above the knee-joint and the head of the tibia. This was opened and a communication was established between the knee-joint and the head of the tibia. The child developed diphtheria. She was removed to the Municipal Hospital and died suddenly the evening of admission.

Excision of the radius may be considered a rare operation although in a search of the literature 20 cases have been recorded. Smith reports a case in a child of 8. The patient had had measles 4 years before the onset of the present trouble. On account of the swelling of the arm the child attended hospitals for two years being treated for sinuses. These seemed to be tuberculous in character. The carpal epiphysis was not removed. The patient used his arm freely and was able to write.

However, the honor of first having removed the radius is claimed by Carnochan, and he claims to have been the first also to excise the ulna. This was in 1855. The patient, a male, aged 18, had received treatment for months without benefit when excision of the radius was performed. Following the opera-

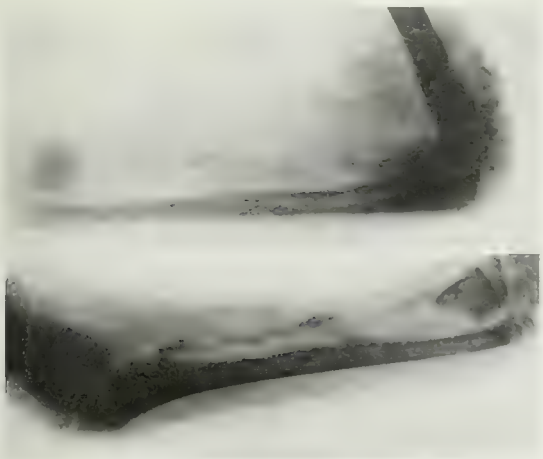

Fig. 4. (at top) Case 1. The radius removed.
Fig. 5. Case 1. Beginning regeneration of the radius.

Fig. 6. Case 2. Necrosis of lower end of the left femur.

tion the patient had good motion, was able to write with a pen, and had good muscular power. He followed again his occupation of laborer. No cause has been assigned for the necrosis of the radius.

According to the literature Smith, in 1848, in the case referred to above, was the first to remove the radius for necrosis.

Fuqua reports the case of a negro child 10 years old with necrosis of the entire shaft of the radius as a result of a fracture two years before. The radius was removed, the entire periosteum remaining. A rudimentary radius was reproduced. The child had good pronation and supination, flexion and extension. Fuqua quotes Gross as saying that, to his knowledge, up to 1859 the entire radius had not been removed. In 1863 Gross removed the entire radius subperiosteally for necrosis following a gunshot wound. The patient recovered and had a useful hand and arm.

Wright says that one rarely finds necrosis of the entire length of long bones. He reports the case of a boy 12 years old who had a fall two years before consultation. Part of the radius had been removed and a year later the remainder of the radius was removed. The patient was able to scratch his head, lift a chair, carry a weight of 15 pounds, feed himself, open a door and write his name.

In 1881 Field referred to Carnochan's case as the only one on record. Field's patient was a boy who after an injury developed fistulous openings. After operation the strength in his arm was good. His infirmity did not interfere with his work and he was able to carry large buckets of water.

Butcher reports the case of a boy of 17, who had suffered a fracture of the lower epiphysis. After he had been treated about a year with various topical applications and constitutional remedies, the radius was removed. The patient could then flex the fingers, and pronation and supination were well done.

Chavasse has had a rather unique experience. His patient suffered from necrosis of the radius from infancy. Sequestrotomy was performed nine times. When the patient was 18 the radius was removed. He was able to feed and wash himself and carry an ordinary bucket.

Belcher reports the case of a boy 9 years old who was admitted to the hospital for sinuses following necrosis of the radius. The radius was removed in two sections. There was no regeneration of the radius.

Carnochan reports the case of a male, age 20, who, following an accident, was treated for three months. The elbow-joint was immovable. In 11 weeks he was discharged

Fig. 7. Case 4. Necrosis of lower end of femur

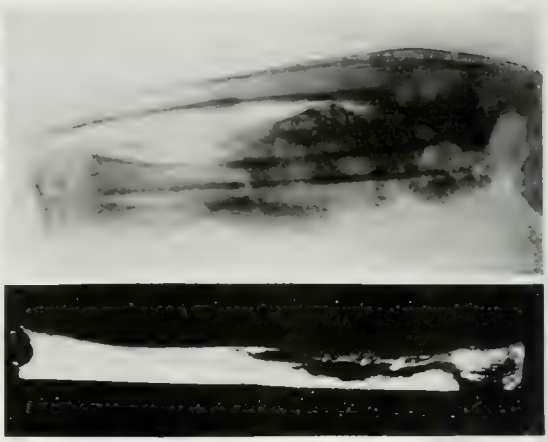

Fig. 8 (at top). Necrosis of the radius. P. G. Skillern's case.

Fig. 9. Sequestrum of radius. P. G. Skillern's case.

cured, and was able to perform the duties of an orderly. Radial disfiguration was present.

Cutter reports the case of a scrofulous child who was compelled to have the radius excised; some of the fingers had been removed at a previous operation.

Chapin reports the case of a negro boy, age 14, who suffered from tubercular sinuses of the arm. The radius was excised at the epiphysis of the wrist. Chapin refers to Velpeau (1839) who always advised amputation in such cases. Quite a controversy arose as to which was the better operation, amputation or resection of the radius. The consensus finally was that excision was the operation of choice and the various reports as to the ultimate function of the arm certainly bear this out.

Duffield cites a case of spontaneous tuberculosis of the radius which was later excised.

Galozzi reports a patient who had been treated for eighteen months without result. The entire radius except the lower portion became necrotic. The periosteum regenerated new bone around the sequestrum. The latter was removed. The wound healed and the patient had a useful arm.

Carl Beck, in 1893, reported a case of regeneration of the radius after its removal for osteosarcoma.

A. C. Godfrey performed excision of the radius for tuberculous disease. For ulnar dislocation from the carpal bones, he recommends a steel support with a hinge corresponding to wrist movements.

P. G. Skillern, Jr., reported the case of a child of 3, who previously had an osteomyelitis of the femur which healed. Necrosis of the radius followed. There was complete regeneration of the radius after its removal. I am indebted to Skillern for the privilege of using his illustrations. These represent exactly the condition as found by the various surgeons whose cases are cited in this paper (Figs. 8 and 9).

Tavernier excised the radius after a low amputation of the arm, following an explosion of dynamite. The excision was performed about two months after the amputation on account of necrosis of the radius. While pronation and supination were diminished, flexion and extension of the elbow were entirely conserved.

The encouraging reports as to the return of function in these cases is quite remarkable. The case reported by the writer shows a return of function also but not to the same degree as that shown by other writers. While the child is able to write and hold his knife and fork, still the normal functions are greatly reduced partly on account of atrophy of the muscles of his hands and arm and a

Fig. 10.

Fig. 10. Case 1. Typical radial deformity following excision of radius.

Fig. 11.

Fig. 11. Case 1. Apparatus designed to overcome the radial deformity.

partial ankylosis of the elbow-joint due to necrosis also of the olecranon process and the condyles of the humerus. There is also present the typical radial deformity noted by various writers. To counteract this deformity the patient wears a steel support as recommended by Godfrey (Fig. 11).

The table of cases in which excision of the radius was performed follows:

Surgeon	Cause	Age of patient	Date of operation	Function
H. Smith	Tuberculosis	12	1848	No report
Carnochan (S. Smith)	No report	18	1855	Good
Belcher	No report	9	1857	No report
Cutter	Tuberculosis	No report	1857	No report
Butcher	Accident[1]	17	1859	Good
Carnochan	Accident	20	1859	Good
Chappin	Tuberculosis	14	1861	Good
Gross	Accident	No report	1863	Good
Galozzi	No report	19	1867	Good
Fuqua	Accident	10	1878	Good
Field	Accident	No report	1881	Good
Duffield	Tuberculosis	10	1880	No report
Wright	Accident	12	1885	Good
Chavasse	No report	19	1885	Good
Beck, C.	Sarcoma	18	1893	Good
Godfrey	Tuberculosis	24	1893	Good
Tavernier	Accident	No report	1913	Good
Skillern	Septicæmia	3	1918	Good
Behrend	Epidem. influenza	9	1919	Good
Erichson[2]			1855	

[1]The accident was followed by necrosis of the radius for which the excision was performed.

[2]No description of this case could be found in the library of the College of Physicians.

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THE FREQUENCY AND SIGNIFICANCE OF OMPHALITIS

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At one time all inflammatory lesions of the umbilical cord were attributed to syphilis. Subsequently this view was discredited, for in many instances omphalitis was demonstrable in cases in which the mother gave no history of syphilis and the familiar anatomical lesions were not present in the fœtus. It has been shown also that in the presence of congenital syphilis, the umbilical cord is very rarely infected with the treponema pallidum. On the other hand, thrombosis of the umbilical vein has been recorded in a case of intrapartum infection in which streptococci were found in the placenta and in the cord. Thus suspicion was directed toward bacterial infection as an important cause of omphalitis, and the problem has been attacked from this angle in the present study. The frequency of omphalitis, the nature of the lesion, its relation to placental bacteriæmia and to fœtal mortality, are all questions of interest especially in view of the great effort now directed toward reducing fœtal mortality.

On microscopic examination of the cord in 2,200 consecutive cases in which the infant weighed more than 1,800 grams, 43 showed leucocytic infiltration of the vessel walls and the adjacent connective tissue. To trace the source and causative factor of this lesion additional sections, both toward the fœtus and toward the placenta, were studied. The clinical results for the mother and for the infant have been tabulated, the histories being analyzed to learn what significant features these cases present.

The lesion consists of an extravasation of polymorphonuclear leucocytes into the wall of the umbilical vein, occasionally into the wall of one or both of the arteries and into the whartonian jelly. Outside the vessels the leucocytes are diffusely distributed in the interstices between the connective-tissue fibers, more compactly at the center of the cord and less densely at its periphery. The lesion varies in severity. It may pertain only to a segment of the vein wall or, at the other extreme, may involve all three umbilical vessels. Rarely thrombophlebitis exists. The lining of the affected blood vessel presents

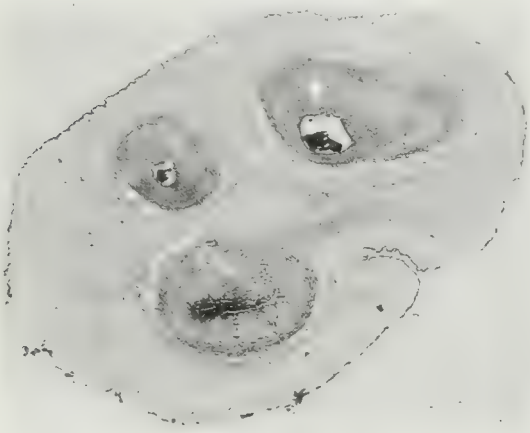

Fig. 1. Normal cord. x6.

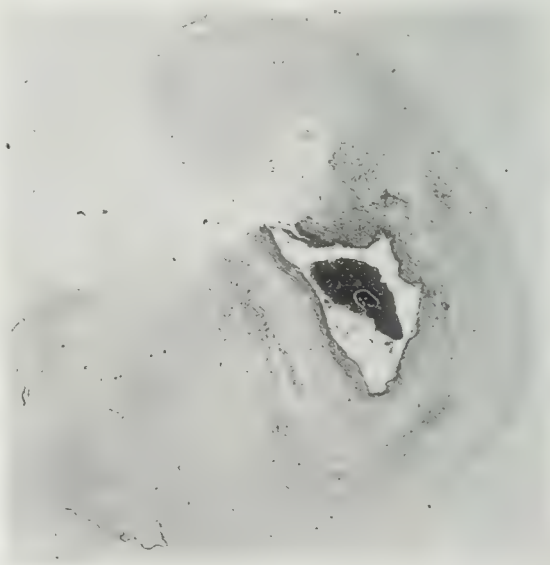

Fig. 2. Portion of affected cord, showing thrombus in vein and adjacent whartonian jelly infiltrated with polymorphonuclear leucocytes.

no increase in thickness, although at times there is dissociation of the connective-tissue fibers of the intima. In two cases perivascular necrosis was present. Typically, the inflammatory exudate consists of polymorphonuclear leucocytes, loosely disseminated, but in two instances these cells were so densely massed as to resemble early abscess formation. On the other hand, occasionally, mononuclear elements were conspicuous, at times proportionately equal to the polymorphonuclear cells.

Frequently a phagocytic macrocyte is present. This large cell with considerable protoplasm and a spherical, deep-staining, granular nucleus appears at the periphery of the cord, wandering in the loose connective tissue beneath the epithelium. The presence of these cells is not peculiar to the lesion; they are also not uncommon in the loose subamniotic connective tissue of the placenta. Their protoplasm is granular and varies in shape from diamond to rhomboid. The rôle these cells play, not clear at present, is nevertheless a conspicuous one and merits further investigation.

Omphalitis, as has been said, was once ascribed to syphilis. In 1903 Bondi reported a study of 35 cords of which 15 occurred in syphilitic patients and showed the characteristic white cell infiltration in the vessel walls of the cord. The other specimens, obtained from patients with non-specific infectious or constitutional diseases, were normal. Therefore, he ascribed this cord lesion to syphilis and stated that the accepted signs of the disease. such as endarteritis and proliferation of the stroma of the cord were rarely present. This view was adopted later by

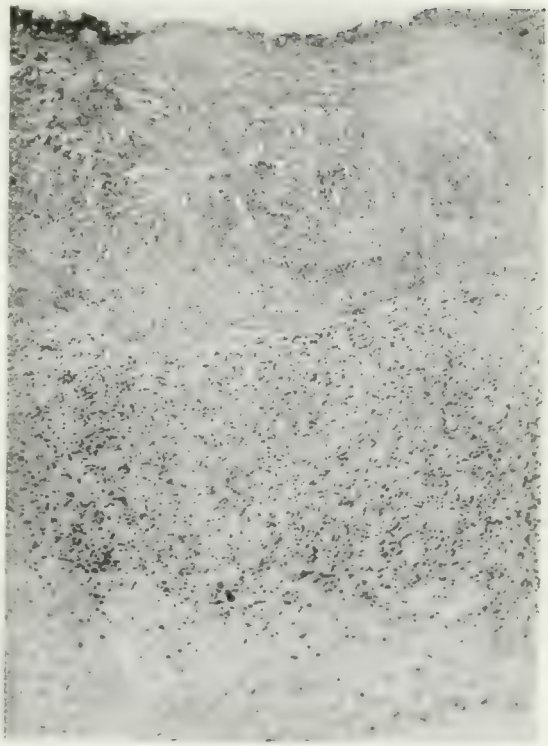

Fig. 3. Infiltration in vein wall and surrounding connective tissue diminishing toward the periphery of cord.

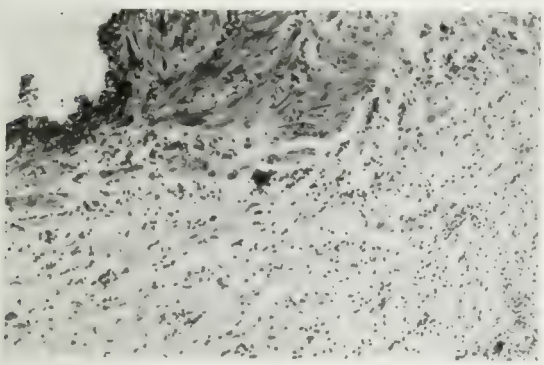

Fig. 4. Polymorphonuclear leucocytes infiltrating vein wall.

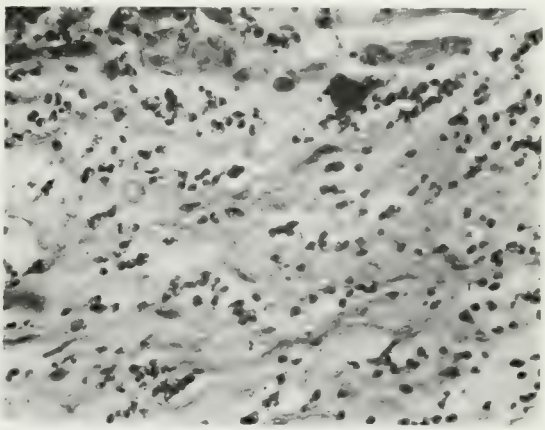

Fig. 5. Dissemination of leucocytes in interstices of connective tissue. High power.

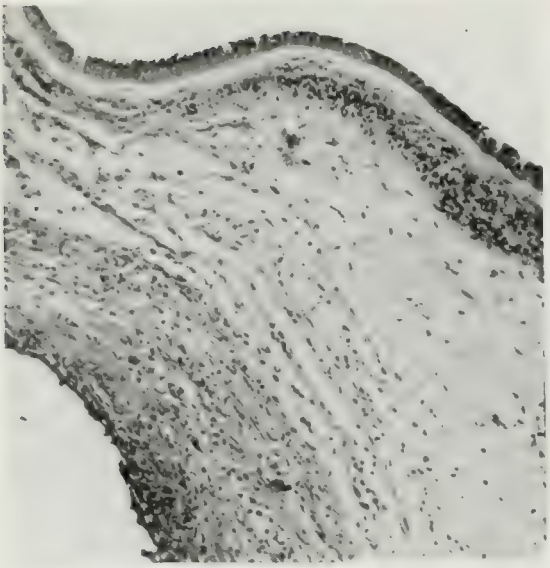

Fig. 6. Fœtal surface of the placenta, with amniotic epithelium, branch of umbilical vein and leucocytic invasion of subamniotic connective tissue.

Thomson who reported a series of 59 cases, one of which showed the characteristic lesion in the cord although the patient denied luetic infection. Thomson, however, regarded the clinical history as less reliable than the microscopic findings Subsequently Thomson and Boas made a control study of 500 cases, the result of which, they considered, served to emphasize Bondi's original statement.

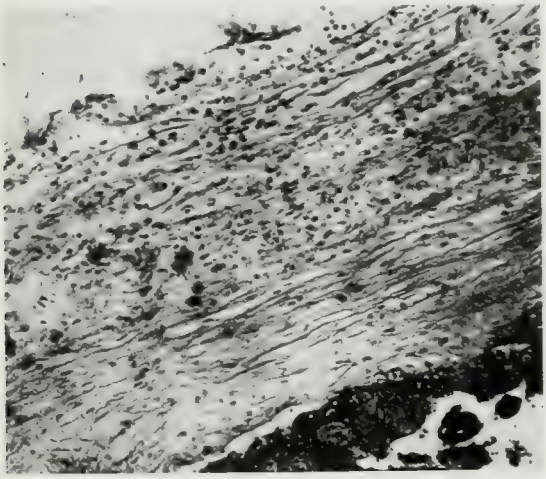

Fig. 8. Sub-amniochorionic connective tissue zone with loss of the epithelium and invasion by leucocytes.

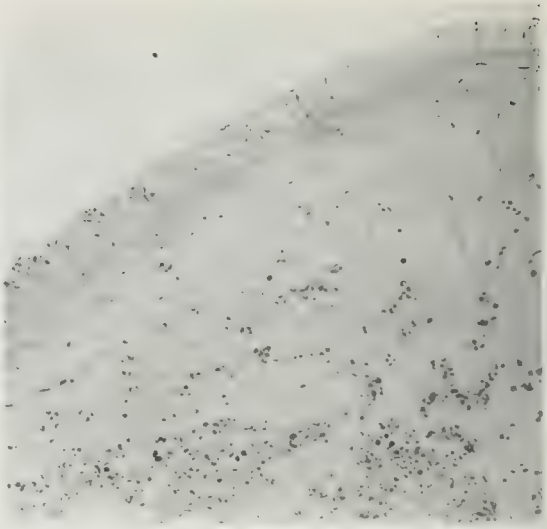

Fig. 7. Amniotic epithelium, showing distortion after rupture of membranes. "Macrophages" and leucocytes in the loose subamniotic connective tissue.

Von Winkel's *Handbook of Obstetrics* and Ziegler's *Pathology* make conservative statements to the effect that the lesion is chiefly syphilitic and point the need for further investigation. In 1912 Simmonds reviewed the subject and denied the specificity of the lesion for syphilis, but suggested no other causative factor. However, he was impressed by the fact that a great number of these patients ran a febrile course in the puerperium.

Among our 43 cases of omphalitis, there were only three mothers who presented a positive Wassermann test as well as a typical histological picture of placental syphilis. On the other hand in the entire series of cases (2200) which are the basis of this report, there were 29 instances of maternal syphilis without any lesion of the umbilical cord. Furthermore in 40 instances of omphalitis, there was no evidence of syphilis.

There were 3 cases of omphalitis in which the mother was syphilitic. The first of these was delivered spontaneously of a child which died on the second day from hæmorrhage of the newborn. The mother had a febrile puerperium. The second entered the hospital after rupture of the membranes, with a temperature of 100° F. and was delivered of a stillborn fœtus. The third entered the

hospital late in the second stage, with a temperature of 99.6° F. and was delivered of a living child. Her temperature rose to 101° F. on the third day on account of a mild puerperal infection.

The statistical evidence just presented demonstrates that syphilis is not commonly attended with inflammation of the umbilical cord. Furthermore, in the majority of cases in which the cord lesion occurs, the mother is not syphilitic. In view of these facts we believe that, in cases presenting syphilis and inflammation of the umbilical cord, two diseases rather than one must be reckoned with. Omphalitis, it is clear, appears so frequently in cases without any sign of syphilis, that its cause must be sought elsewhere. Fortunately, its origin need no longer be left to conjecture. It depends, we find, upon bacterial invasion of the placenta, and the latter lesion generally occurs in cases in which the membranes have ruptured prematurely.

Infection of the contents of the pregnant uterus, as Hellendall has shown by animal experimentation, may occur by three routes: (1) the transamniotic, usually with, but occasionally without, the previous rupture of the membranes; (2) by way of the maternal blood as in smallpox; and (3) by way of the fallopian tube from the abdominal cavity, as in appendicitis. To this statement Warnekros added that in cases of transamniotic infection of the placenta, two mechanisms are possible: (a) that by which organisms are transmitted through the amniotic fluid directly to the fœtal surface; and (b) that by which they proceed from the point of rupture of the membranes along their surface to the nearest placental margin. Slemons has reported cases of placental bacteriæmia in which organisms were found invading the subamniotic connective tissue. These cases showed also the typical leucocytic invasion of the cord; in one there was thrombosis of the umbilical vein.

Since the lesion of the umbilical cord, as originally described by Bondi, accompanied the subamniotic invasion reported by Slemons the next step was to discover what relation, if any, the two might have. Sections through the insertion of the cord upon the placenta were made. At this point the fœtal vessels divide to spread over the fœtal surface of the organ. In every case of omphalitis, the branches of the umbilical vein at the root of the cord were involved in an inflammatory reaction, but the arteries of this area were involved in only one instance. The course of the inflammatory process could be traced backward along the veins into the subamniotic connective tissue. The direct continuity of the lesion, just indicated, was demonstrable in 38 of the 43 cases of omphalitis. In the 5 negative cases, a limited quantity of placental tissue had been preserved and its study was correspondingly restricted. The evidence at hand, therefore, indicates that generally, if not always, omphalitis is preceded by bacterial infection of the placenta.

The latter lesion, as I have said, is prone to occur in cases where the membranes rupture prematurely. Here, the retraction of the uterus preceding delivery reduces the size of the amniotic cavity, forces the amniotic epithelium to change from cuboidal to a high columnar type and restricts the basal attachment of the cells. The nuclei pressed upward toward the surface of the amnion are occasionally expelled from the cells which consequently undergo necrosis. Obviously, injuries of this kind impair the protective action of the epithelium against bacterial invasion and, if bacteria are present in the amniotic fluid, they may enter the subamniotic connective tissue and the walls of the fœtal vessels which cross the placenta. Premature rupture of the membranes was noted in 26 cases, or 60 per cent of the cord infections. In 13 of these cases, rupture of the membranes occurred from 18 hours to 5 days before the onset of pain.

It is well known that any factor which tends to lengthen the duration of labor increases the risk of infection. From this viewpoint, the clinical histories of the cases of cord infection present certain significant features, for not infrequently the familiar causes of the prolongation of labor were present. Thus, 16 were primiparæ, and 13 had contracted pelves causing dystocia, though only 2 of these required operative assistance. In the series there were three breech pre-

sentations, three persistent occiput posteriors and one transverse presentation. In 25 cases the delivery was spontaneous and in 18 an appropriate obstetrical operation was performed. The duration of labor was prolonged in 25 cases, including 13 of the primiparæ, which represents 58 per cent of the cases in which omphalitis occurred.

Some degree of fever during labor, an outstanding feature of infection, was noted in 22 cases of omphalitis. The temperature varied from 99 to 102° F. In some instances the temperature was not recorded and in others an observation was made only at the very onset of labor. While these data are incomplete, our experience teaches that, in the presence of intrapartum fever, infection of the placenta is the rule and frequently the umbilical cord becomes involved. If fever occurs in conjunction with premature rupture of the membranes and prolongation of labor, infection of the placenta with extension to the cord becomes almost certain.

The ultimate result for the mother and for the infant in cases of intrapartum fever becomes a matter of the first importance. For the mother it appears that the danger is greatly reduced by the expulsion of the placenta, and usually the temperature falls when the delivery is complete. On the other hand maternal infection may declare itself 48 to 72 hours after delivery. This was noted in 11 of the cases of omphalitis, but the puerperal sepsis was mild, with no maternal deaths.

For the infant the results are more serious. Fourteen infant deaths occurred among the 43 cases of omphalitis, yielding a mortality of 32.5 per cent. There were 8 stillbirths; 3 infants died on the first day after birth, 2 on the second and 1 on the fourth day. This very high mortality, it must be made clear, cannot be attributed to the cord lesion which of itself may become the cause of death only when the cord vessels are thrombosed. Generally, we believe, the death of the fœtus or of the infant is attributable to infection of the fœtal blood, although at times it is impossible to determine what rôle an operation to effect delivery has played in the death of the infant. One fœtal death followed a placenta prævia; in 3 additional cases, lacking autopsy findings, the question of the cause of death remains undifferentiated between infection and injury. The remaining fatalities we ascribe to placental bacteriæmia. If 23 per cent of these intrapartum infections were fatal to the fœtus, it is of considerable moment, and precaution must be taken to reduce the frequency.

TABLE OF INCIDENCE AND MORTALITY OF INFECTION OF THE UMBILICAL CORD

Group	Number of Cases	Cord Lesions	Incidence Percentage	Deaths	Mortality Percentage
A	1200	26	2.1	11	42.3
B	1000	17	1.5	3	17.6
Total	2200	43	1.9	14	32.5

The value of precaution in the conduct of labor is proved by these statistics which may be classified chronologically into two groups: (a) the earlier, including 1,200 cases, pertains to a period when placental bacteriæmia was given no special consideration; (b) the later, consisting of 1,000 cases where strict precaution was observed—especially the limitation of vaginal examinations—in prolonged labors and after the rupture of membranes except as a preliminary to some operative procedure to effect delivery. In the first group 26 cord infections were encountered with an infant mortality of 42.3 per cent while in the second group there were 17 cord infections and a mortality of 17.6 per cent. This decrease in the number of infections as well as in their severity we ascribe chiefly to the substitution of rectal for vaginal examinations.

SUMMARY

In conclusion the results of this study may be summarized as follows:

1. In a series of 2,200 consecutive deliveries, an inflammatory lesion of the umbilical cord has been found in 43 cases.

2. The lesion is not pathognomonic of syphilis, for (a) it was present in 40 cases where there was no evidence of syphilis, and (b) it was absent in 29 cases of undoubted syphilis.

3. The lesion arises by the extension of bacterial infection from the placenta.

4. Bacteria are frequently demonstrable in sections of the cord.

5. The lesion is commonly associated with prolonged labor after premature rupture of the membranes.

6. The frequency of these infections and the resulting infant mortality may be reduced by the use of rectal in place of vaginal examinations.

NOTE:—The following pertinent case has been treated in the clinic since this paper was completed.

After a prolonged labor a primipara was delivered spontaneously of a living child. Its temperature frequently reached 101° and it took nourishment poorly. On the eighth day blood cultures were positive for streptococci. Death occurred on the eleventh day and at autopsy empyema and purulent pericarditis were found. Streptococci and bacillus coli were isolated. Sections of the placenta and cord showed the lesions described associated with streptococci. The mother had a mild grade of fever on the third and fourth days postpartum but otherwise had an uneventful convalescence.

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RUPTURE OF THE RECTUM DURING LABOR

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THERE are numerous instances in the literature of rupture of the rectum but in a careful search of the standard books on obstetrics and rectal diseases, I have been unable to find a case occurring during labor. In a personal letter from Joseph B. De Lee, of Chicago, he stated that he has never seen a similar case.

Wallis (1) states that certain rectal strictures are due to pressure of the child's head during labor; Fulton (2) reports a positive case of stricture of the rectum following a prolonged labor; Tuttle (3) mentions perforation of the rectum in cases of stricture of the rectum due to syphilis, but no mention is made as to its occurrence during delivery.

As syphilitic stricture of the rectum occurs mostly in women, it is remarkable that this accident is not more frequent during childbirth. It can be readily seen that as the rectal wall above the stricture is dilated and weakened, and that as there is generally a condition of coprostasis present, the pressure of the fœtal head descending would cause a pressure on the accumulated fæcal material which, unable to pass downward, because of the stricture, bursts through the rectal wall.

In the case herein reported we were in the dark as to the exact condition. Rupture of the uterus was suspected. As the woman was in such a profound state of shock, an exploratory laparotomy was contra-indicated. A rectal examination threw no light on the condition as the perforation was far beyond the reach of the examining finger.

Patient, female, age 37, entered hospital in a state of profound shock. Pulse 156, temperature 102, respiration 42. Skin gray, lips cyanosed, and face covered with perspiration. Abdomen greatly distended. She gave the following history:

Family history: The mother and father are living and well. The husband is in good health. The patient has had 3 children, all living and well.

Present trouble. The patient was delivered at her home 30 hours prior to entrance to hospital. A low forceps operation was performed and almost immediately after the delivery of the child the patient complained of severe pain in her left side and soon afterward began to show signs of shock. Twelve hours later she developed abdominal symptoms and was sent to the hospital. The general physical examination was negative. The abdomen, as stated before, was greatly distended, tympanitic except over uterus which gave a dull area 1 hand's breadth above symphysis. The distention of the abdomen was so great that the skin was broken in several areas. The vaginal examination revealed a soft, boggy, puerperal uterus, and a recent bilateral laceration of the cervix, also a recent perineal laceration. Slight lochia but no odor, and negative on microscopic examination. Leucocyte count 21,000. Rectal (low) examination was negative.

Subsequent history. No definite diagnosis was made except that there was a peritonitis present. Three hours after entrance the patient had an almost imperceptible pulse. Temperature 104.8°, body surface cold and clammy. Condition of patient gradually became worse and she died 12 hours after entering hospital. Her last temperature before death was 107°.

Postmortem examination by Dr. F. A. Baldwin. Acute diffuse fibrinous peritonitis; rupture of rectum at the rectosigmoidal junction; old stricture of rectum (syphilitic); postpartum uterus; cloudy swelling of liver and kidneys; acute congestion of spleen, œdema of lungs; acute dilatation of heart; no perforation of vagina; appendix negative; recent laceration of perineum.

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INFECTIONS OF THE KIDNEY IN GYNECOLOGIC PRACTICE[1]

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THIS paper is presented not with the idea of contributing anything original but solely with the purpose of bespeaking a more accurate clinical observation of possible lesions of the urinary tract than these sometimes receive. During the past 15 months there have come under the observation of the writer 25 cases of pyelitis of which one was bilateral, 3 cases of pyonephrosis, 1 case of congenital cystic kidney, 1 case of obstruction of the ureter by an aberrant renal artery, 2 of tubercular kidney, and 1 case of pyelitis associated with imperforate vagina and absent uterus. Of these cases of pyelitis all were of colon bacillus origin but 2, 1 of which showed a growth of pneumococcus and 1 a growth of staphylococcus. This latter can very well have been a chance contamination as staphylococcus may be found as inhabitants of the normal bladder.

It seems therefore that the gynecologist must find himself at times trespassing upon the field of the urologist. Kidney infections in women are so common that anyone who sees very many gynecological cases cannot fail frequently to see women in whom infections or other lesions of the kidney are present. It is estimated that pyelitis occurs four or five times as frequently in women as it does in men and when we take into consideration the frequency of this lesion during pregnancy the ratio does not seem excessive.

In considering etiology there does not seem to have been sufficient stress laid upon infections of the urinary tract which occur in infancy. About two years ago, following a suggestion of Helmholz, who had within a short space of time seen several very young babies with cystopyelitis, it was made a routine in the gynecologic-obstetric service of the Evanston Hospital, to obtain samples of urine from all infants in the ward service as soon as possible after birth and from all infants of my own private patients. Since that time the number of instances in which pus has been found in urine of infants of a few days old has been striking. It seems fair to assume that many unrecognized and there-

[1] Read before the Chicago Gynecological Society, November 21, 1910 (For discussion, see p. 316.)

fore untreated infections of the kidney in infancy may be the starting point for urinary lesions of a more serious character in later life, and it is suggested that a careful routine observation of urinary findings during the first week of life in maternity hospitals and the active routine treatment of urinary infections revealed thereby would serve as a preventive measure of considerable value.

As to the route through which infections may reach the kidney, we may consider the following:

1. Ascending infections through the lumen of the ureter. The possibility of infections arriving in the kidney by this means must be admitted. Cystograms have shown that fluid in the bladder may travel upward into the ureter, particularly if the latter be dilated. That a retrograde peristalsis may occur in the ureter comparable to that occurring in the intestine in cases of intestinal obstruction, is evidenced by an observation of Kretschmer that a stone which has traveled down to the lower levels of the ureter may again be propelled upward and found again on later radiography to lie at a considerably higher level than that at which it had previously been observed. While this is probably not a frequent mode of transmission of infection it must be regarded as a possibility.

2. Transmission upward of infection through the lymphatics and the wall of the ureter. This possibility was pointed out some years ago by Bauereisen and the same mode of transmission of infection was experimentally studied some years later by Eisendrath. Cabot and Crabtree, however, two years ago, suggested in arguing against this mode of transmission, the anatomical fact that in regions of the body where the course of the lymphatics has been demonstrated, it has been found that they in general have followed courses pursued by the blood vessels supplying the region. While the actual course of the ureteral lymphatics has, I believe, not yet been demonstrated, it is known that the blood supply of the ureter is a segmental one, that is, its vessels traverse its wall for a certain distance and then leave it. If the lymphatics follow their usual rule in following the blood vessels of the ureter, they would therefore be prone to leave the wall of the ureter before arriving at the level of the kidney. Infection, therefore, could scarcely travel in an unbroken path the length of the ureter through the lymphatics.

3. The lymphatic connection between the cæcum and ascending bowel has been pointed out by von Franque, a route by which infection may pass directly from the bowel to the ureter. A certain relationship between apendicitis and lesions of the right kidney has been suggested by some of the French writers.

4. By all means the most common route by which infection reaches the kidney is the blood stream. As colon bacilli are always present in enormous quantities in the large bowel, they must be present at times, if not constantly, in the blood stream. Bacteria are excreted by the kidney parenchyma without damage to the latter under normal circumstances. When, however, the drainage from the kidney is impeded or the individual's resistance may be lowered, infection may occur.

Any one who has had occasion to observe the urine in large numbers of cases of pregnancy is aware of the frequency with which pyelitis occurs in these cases, the exciting factor being pressure upon the ureter by the pregnant uterus. It may also, I think, be safely stated that many women pass through pregnancy with an infected kidney of mild degree which fails of recognition. A very large percentage of these cases, because of cessation of treatment after the pyelitis has been symptomatically relieved, which usually occurs after labor, or because it has not been recognized at all, are not followed up to the point of bacteriological cure, hence many of them may later develop an attack of pyelitis. Cabot and Crabtree have pointed out that non-tubercular infections of the kidney are divided into three classes: those of bacillary origin, caused by bacilli of the colon group, which are prone to limit themselves, at least at first, to the kidney pelvis. These are the most easily curable and by all means the most frequently seen in women. Second, those of coccal origin which select the kidney parenchyma, and third, those of mixed coccal and bacillary character which may attack both pelvis and parenchyma.

These infections the gynecologic surgeon is constantly seeing. Frequently a confusion as to diagnosis arises between pyelitis and appendicitis, many cases of kidney infection being looked upon as inflammation of the appendix. It has happened recently in my own experience to be asked twice in one week by two different physicians to see women in whom an acute appendicitis was assumed to be present, in both of whom the real lesion was a colon bacillus pyelitis which was easily demonstrated by urinary examination and ureteral catheterization and both of which were promptly relieved by appropriate treatment.

A certain resemblance in the symptomatology which may occur in these two processes may easily deceive the unwary. The usual symptoms of pyelitis are pain in the infected kidney together with tenderness in the corresponding costovertebral angle, frequently fever, elevation of leucocyte count, pain extending along the infected ureter with tenderness over the ureter in the lower abdomen. When the lesion is on the right side, particularly if nausea accompanies it, which is sometimes the case, the hasty observer may easily conclude that it is the appendix which is involved. Right costovertebral angle tenderness and the presence of pus in a catheterized sample of urine will suggest the possibility of kidney infection which may easily and quickly be proved by the use of the cystoscope. No woman should be operated upon for acute appendicitis unless the appendicitis be a very clearly defined attack, until the possibility of an acute pyelitis is eliminated.

During pregnancy it has long been a rule that no appendectomy should ever be done without a previous microscopic examination of the urine. The abdominal surgeon may also well afford to follow a similar precaution.

As to the treatment of pyelitis, my own experience has brought me to the consideration of but one means of treatment; namely, lavage of the kidney. It seems fair to say that in cases of simple pyelitis in which the parenchyma of the kidney is not involved, a cure may practically always be attained by this means. Much argument has been had as to whether it is the simple drainage by means of the catheter and the possible widening of the lumen of the infected ureter, the mucosa of which may have been swollen as a result of infection, by the mechanical pressure of the catheter, or whether it is the use of an antiseptic solution which is deposited directly in the infected area. My own opinion is that the antiseptic plays an important part. In mild pyelitis, however, associated with a severe cystitis, lavage should not be practiced until the cystitis has been treated and its severity lessened, if possible.

Treatment of the pyelitis should also be associated with relief of constipation, establishment of regular bowel drainage, and the administration of bulgarian bacillus to reduce the activity of the colon bacillus in the bowel as far as possible.

The kidney is irrigated at intervals of four days with a solution of nitrate of silver varying from 1:300 to 1 per cent, the number of lavages necessary varying from 1 to 6, but are oftenest 3 or 4. The very frequent practice of treating what appears to be a cystitis by medication by mouth or vesical irrigation without any definite attempt to discover from whence the cellular elements in the urine come, cannot be too strongly condemned.

It is possible that the very recent work of Young, White, and Swartz of the Brady Institute at Johns Hopkins with mercurochrome-220, may be the means of putting us in possession of a new and valuable drug for use in infections of the urinary tract.

The criterion of the cure is not the appearance of clear urine or one in which no cellular elements are to be observed microscopically. Certain evidence of cure is only at hand when at least one, or better two, successive urinary cultures fail to show the presence of bacteria.

An illustration of the consequence of failure to recognize infections of the kidney may be illustrated by the following case:

A woman of 42 on the occasion of her last labor, nine years previously, states that she had a cystitis. She does not remember having had pain in the back during pregnancy. The cystitis was treated by vesical irrigation on several occasions and in the past few years she has had further attacks of bladder infection which have been treated in a similar way. During the past year she has constantly had trouble with the bladder with some discomfort in

the right lumbar region and has been losing weight. Recently she came under the observation of another physician, who, for the first time, recognized that there was a mass palpable in the right upper abdomen. Upon my seeing her I agreed that this was undoubtedly a pyonephrosis, as the urine was heavily loaded with pus, and upon cystoscopy this was easily demonstrated, the infective organism being the colon bacillus. A functional test showed the other kidney to be in excellent condition. Nephrectomy was carried out removing a large pus kidney containing five stones. This woman undoubtedly had had during pregnancy an infected kidney, which, had it been taken care of at that time and treatment continued during the puerperium to the complete recovery, might perhaps have saved her kidney.

An illustration of the ease with which obscure lesions of the kidney may be overlooked and of the truth of the rule that neurosis should only be assumed when painstaking study fails to reveal a real cause for symptoms, is illustrated by the following:

A girl of 19 entered the medical service of the hospital complaining of pain in the right side of the back. She gave a history of having recently been in one of the large hospitals of the city where she had remained for about two weeks and had been discharged after having been told that she was a neurotic. While the girl was unquestionably nervous, the medical man under whose observation she was, was quite convinced that neurosis did not explain the pain, inasmuch as it was always constant in its location and suggestion would not cause her to complain of pain elsewhere. Tenderness was invariably present over the right costovertebral angle. Examinations carried out on other parts of the body, such as the apices of the lungs, with the idea of distracting her attention, followed by sudden percussion over the painful area never failed to elicit complaint. The nurses while making her bed and otherwise caring for her were instructed to strike her with apparent inadvertence in various parts of her anatomy, but without result except when the right costovertebral angle was attacked when she invariably complained of pain. The urine was absolutely negative, cystoscopies were negative and catheters passed into both kidneys without trouble. Urinary cultures from both kidneys were negative and it was only when a pyelogram was made showing that the kidney would hold between 13 and 14 cubic centimeters of fluid, that the nature of the lesion began to be suspected. She had a hydronephrosis, which, without any history of infection or obstruction in the ureter, seemed difficult to explain. A diagnosis was, however, ventured of an obstruction of the ureter due to an aberrant renal artery, in spite of the fact that the pyelogram showed no kink in the ureter. She was then operated upon by a colleague on the surgical service, exposure of the kidney showing an aberrant artery about the size of a goose quill entering the kidney at the lower pole over which the ureter was looped. The kink in the ureter was undoubtedly straightened out by the catheter and so did not show in the plate. After operation the pain disappeared and a report received recently, four months after operation, indicates that she is entirely free of pain.

One other interesting case was seen, that of a girl of 22, who was referred for pyelitis.

On examination she was found to have an imperforate vagina, there being merely a pouch 5 centimeters deep lined with mucosa. She had had discomfort at monthly intervals but of course no flow. A small mass apparently about 2 centimeters long could be felt by bimanual examination just above the upper limit of the vagina. No ovaries could be felt. Laparotomy was done at the request of the family to see if anything of a reconstructive nature could be done, although it was explained that this was quite unlikely. Exploration disclosed two small ovaries attached to the lateral walls of the pelvis, in one of which was a recent corpus luteum, passing downward from which were two retroperitoneal cordlike structures, the undeveloped muellerian ducts, which united in the median line to form a small fibrous mass about 2 by 1 centimeters in size, the undeveloped uterus.

My only purpose in this paper is to emphasize the frequency with which infections of the kidney may occur in women and to urge a more careful routine observation. Any woman in whose urine pus or blood cells appear is entitled to a careful effort to determine the source of the pus or blood and the nature of the infection, if any. An exception to this is the woman with a pyelitis of pregnancy in whom cystoscopy should be avoided if possible, but in whom it should be used if needed. The fact that within the past eight weeks four cases of tumor of the bladder have come under my own notice, would lend emphasis to this statement. One of these had been treated for ten weeks for intermittent hæmaturia. Cystoscopy disclosed an inoperable carcinoma of the vesicovaginal septum which is now under treatment by X-ray and radium.

CONCLUSION

1. Diagnosis is practically always possible if all means for arriving at a diagnosis be used.

2. Early recognition and treatment of a pyelitis may be the means of avoiding serious if not irreparable damage to the kidney.

MATERNAL MORTALITY, A CRIME OF TODAY[1]

By C. HENRY DAVIS, M.D., Milwaukee, Wisconsin

IN the past thirty years deaths from many diseases have been cut to a fraction of their former tolls. Between the years of 1890 and 1915 the death rate, per 100,000 population, for tuberculosis in the death registration area of the United States, fell from 252 to 145.8; pneumonia from 186.9 to 82.9; diphtheria and croup from 97.8 to 15.7; diarrhœa and enteritis under 2 years from 139.1 to 59.5; typhoid fever from 46.3 to 12.4.

The introduction of anæsthesia, aseptic methods, pre-operative treatment, and technical skill have made surgery so safe that surgeons think little of doing an exploratory laparotomy to make a diagnosis; and even some obstetricians deliver their patients by cæsarean section on the slightest indications.

During the past five years most of the world has been at war. In this war all the diabolical means of torture and death ever conceived of by the human mind have been to some extent employed. Millions of men have been wounded and sick. For the first time in history, battle has caused more deaths among our soldiers than disease. According to weekly bulletin No. 59 of the Chief Surgeon, S.O.S., of the A.E.F. "of the cases of disease: 90.2 per cent returned to duty, 6.0 per cent were invalided home, 3.3 per cent died in hospital, and 0.5 per cent deserted. Of the cases of traumatism: 73.8 per cent returned to duty, 21.1 per cent were invalided home, 5.7 per cent died in hospital, and 0.4 per cent deserted."

Yet in this day of progress and scientific medicine the act of becoming a mother remains as deadly for the average woman as it was before the discovery of anæsthesia and the introduction of antiseptic methods. The present maternal mortality is the greatest medical crime of today. A small group of physicians interested in obstetrics and the diseases of women have long appreciated that most of the maternal deaths are preventable. In their own work puerperal sepsis is a condition almost unknown except as it is seen in consultation. Very few deaths from the other complications of the puerperal state occur among the women they have carried through the entire period of pregnancy, labor, and the puerperium. The work of these physicians is ample proof that the present mortality is not due to the lack of scientific knowledge regarding obstetrical problems, but rather from failure to apply this knowledge. Women have always accepted the mortality and morbidity of childbirth as a sacrifice which they must lay on the altar of motherhood. This function of woman has always been cloaked with fatalism and guided by ignorance.

Between the ages of 15 and 45 childbirth is the second greatest cause of death among women. For the year 1915, in the registration area of the United States, there were, among women of these ages, 29,200 deaths from tuberculosis; 10,134 from childbirth, of which 4,173 were from puerperal sepsis; 8,766 from the various circulatory disturbances; 6,458 from all kinds of digestive disturbances; 5,549 from pneumonia, all types; 5,424 from cancer and other malignant tumors; while for these ages syphilis was reported as the cause of death 647 times and gonorrhœa 174 times.

Mortality statistics are always more or less inaccurate. Most writers believe the deaths from childbirth considerably greater than indicated by the above figures. However, we may assume that the errors will average up from year to year, and that similar errors will be made here and abroad. Dr. Meigs, in preparing her bulletin on maternal mortality for the Children's Bureau of the Department of Labor, studied the mortality records of sixteen countries. In deaths from puerperal sepsis the United States was fourteenth on the list. Only two, Switzerland and Spain, showed a higher death rate per 100,000 population.

It is unfortunate that the death rate from

[1] Read before the Chicago Gynecological Society, November 21, 1916. (For discussion, see p. 318.)

puerperal sepsis and other diseases caused by pregnancy and confinement has been estimated only per 100,000 men, women and children. The death rate per 1000 live births in the United States is only available for the year 1910 in the provisional birth-registration area and in 1915 and 1916 in the newly-established birth registration area.

In the provisional birth-registration area for the year 1910, one mother was lost for every 154 babies born alive. In Belgium for the same year the ratio was one maternal death for every 172 live births and in Spain one to every 175. Sweden on the other hand, had a record of one mother lost to every 430 live births.

Statistics show that grouping all women of child-bearing age together, tuberculosis alone is more deadly than childbirth. But if we leave out of consideration the ignorant foreign and tenement population among whom tuberculosis is so deadly, childbirth leaps to the front.

It is generally conceded that the type of man who carries life insurance with any of the old line companies, is representative of our best citizens. From the records of these companies we may hope to get some idea as to the relative frequency of death from different causes among the typical American citizens.

Through the courtesy of Dr. J. W. Fisher, medical director of the Northwestern Mutual Life Insurance Company, I have checked the family histories of 5000 applicants for life insurance. Both declined and accepted risks were included. These show that one man in every 17 who applied for insurance had a mother or sister or both who died from the immediate effects of childbirth; one in 27 from tuberculosis; and one in 47 from cancer or other malignant tumor. It is probable that a study of 100,000 applicants would modify this ratio to some extent. But checking the applications thousand by thousand as the series grew, it is found that childbirth always remained in the lead. Nor was there a great variation in the different years from which applications were studied.

I have long appreciated that our hospitals were constructed for the very poor and the well-to-do, but I was not prepared to believe that childbirth was so fatal for the mother and sisters of the average American citizen.

Have we as members of the Chicago Gynecological Society and teachers of medical students realized the present mortality from childbirth? If so, have we done our full duty toward bettering conditions in Chicago or elsewhere? Hospital beds for obstetrical patients are so scarce that less than 10 per cent of the women of Chicago can go to a hospital for confinement. The members of this society directly and indirectly through their hospital and dispensary services care for less than 10 per cent of the women delivered in Chicago. Nine-tenths of the women in Chicago and elsewhere are confined by midwives or physicians who are in the general practice of medicine or surgery, few of whom have had any special interest or training in obstetrical problems. Mortality statistics show that in 1916, 179 Chicago mothers died from puerperal sepsis and 220 from other puerperal affections.

Figures may be juggled, but the fact remains that the present maternal mortality is the greatest medical crime of today. However, destructive criticism is of itself useless. The profession may plead for leniency when charged with a crime of which it is not aware, but ignorance of the fact excuses no man if he has failed in his duty. It is the duty of every physician who undertakes to confine a woman to give her the best of his skill. Granting that the average physician has little skill in the management of an obstetrical case, he may at least try to give her a clean delivery. Much of the blame lies at the door of the medical colleges.

Obstetrics has always been the most exhausting branch of medicine and the poorest paid. That being the case, it was only natural that as the numerous commercial schools of medicine were developed it was difficult to persuade a doctor that the teaching of obstetrics would bring him a lucrative consultation practice. You are all familiar with the way those medical schools gave over a large part of their work to grandstand clinics in major surgery. Our medical colleges are still giving far too much time to the teaching of major surgical operations.

Due to the long-continued efforts of a small group of men interested in science of obstetrics the teaching of obstetrics is gradually being improved, but it is still the poorest taught subject in the average medical school. As an undergraduate at Rush I saw three normal deliveries. The graduate of today has seen at least twelve, and has usually had the opportunity to deliver one or more women under direction.

The man who goes into general practice, and a majority of our medical graduates do, must of necessity do more or less obstetrics. He must get his obstetrical knowledge as an undergraduate student or as a hospital interne. The average interne gets little or no obstetrical experience and goes into practice with only the superficial knowledge gained as an undergraduate. The present high maternal mortality is the logical result.

This unnecessary maternal mortality must be corrected, to a great extent, through the efforts of the specialists in obstetrics and gynecology. The dual specialty is and should remain a single specialty. The younger man entering it should do the harder, more demanding obstetrical phase while he is developing the mature judgment and technical skill required for the difficult obstetrical or gynecological operation. Later when less able to stand the strain of night work with broken sleep, he may take less of the normal obstetrics, turning it over to the young assistant, and reserve his strength for the cases requiring experience and operative skill. All the efforts to separate these specialties have retarded their progress, and, have turned hundreds of capable young assistants into practitioners of general surgery.

The American people must be informed regarding the dangers from the lack of surgical cleanliness and reasonable skill in the lying-in room. Hospital beds will not be forthcoming until women are educated to the fact that there is as much reason for going to a hospital to have a baby as there is for most of the surgical operations. Making the world safe for Democracy has been a popular slogan. However, most of us who wore the uniform were fighting to save our women from the horrors of an invasion. The war is over and the ravages of Belgium and France may soon be forgotten in the mad struggle for power and commercial supremacy. Already many of the people who claimed to be most bitter against the German are struggling for his trade. Will we who donned the uniform in a worthy cause return to our various hospitals and calmly ignore the crime at the door of our own profession?

INTRACRANIAL PRESSURE[1]

By CASSIUS C. ROGERS, A.M., M.D., F.A.C.S., Chicago

THE structures within the cranial cavity are normally just sufficient to fill it and nature has provided ways and means to maintain therein a relative constant pressure. Pathological conditions may so interfere with nature that a negative pressure or positive pressure exists. In either instance characteristic symptoms will be manifested. Often a slight negative pressure will produce more distressing symptoms than a relatively higher positive pressure. This is proved by the distressing headaches following the withdrawal of varied quantities of cerebrospinal fluid.

Either a negative or positive pressure may be produced by conditions from within or without the cranial cavity. The loss of cerebrospinal fluid or large quantities of blood are the most frequent cause of negative pressure. Even death has resulted from a too rapid withdrawal of spinal fluid, decreasing intracranial pressure.

It is my purpose to consider positive pressure in this paper.

The cranial cavity is bounded (except in infancy) by a firm non-elastic bony wall incapable of yielding except to great intracranial pressure. It is also surrounded by the second non-elastic structure, the dura, which yields but slowly to intracranial pressure and never rapidly enough to relieve acute conditions.

Positive pressure may be acute or chronic, the symptoms differing greatly with an equal amount of pressure. Of the acute the most frequent cause is perhaps injuries of the head with or without skull fractures. Intracranial lesions without fracture are often more serious than those accompanied by fracture.

A compound comminuted fracture without laceration of the dura produces within itself a decompression rendering extradural pressure impossible at the site of injury but intradural pressure may be but little relieved unless the dura is also severed. Cerebral hernia is always the result of increased intracranial pressure and no attempt should be made to reduce it by external pressure. If, however, the pressure becomes normal the hernia spontaneously disappears.

It must be remembered that intracranial hæmorrhage either extradural or intradural is never sufficient in quantity to kill, but it is the small hæmorrhage that would be considered trivial elsewhere, accompanied by œdema produced by irritation, that causes intracranial pressure sufficient to destroy life.

Acute extradural or subperiosteal pressures from hæmorrhage give symptoms that are pathognomonic and cannot be mistaken if closely observed. If the patient is unconscious, subjective symptoms cannot be obtained but if the pulse, temperature, respiration, and blood pressure are closely and frequently observed they will tell the exact condition of the patient and these alone will invariably tell, if properly interpreted, whether surgical relief is indicated. The acute pressure has a tendency to lower pulse, temperature and respiration, and increase in a direct ratio the blood pressure. The chart illustrates this.

If at the time of injury or hæmorrhage the patient is normal, if after a certain time the pulse is 60, temperature 98, respiration 16,

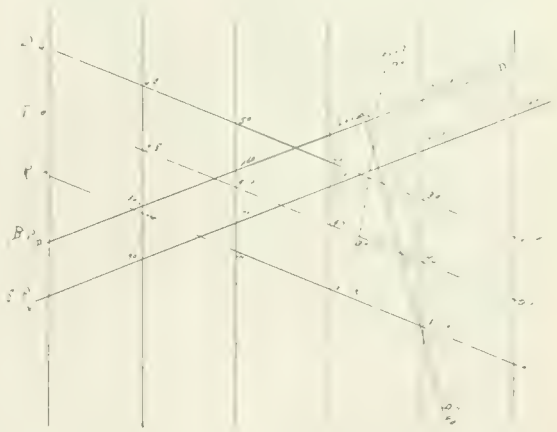

Chart showing acute extradural intracranial pressure. aa′, Pulse; bb′, temperature; cc′, respiration; dd′, blood pressure; ee′, spinal fluid pressure; D″D″, sudden drop in blood pressure; B″B″, sudden rise in temperature, at the same time a fall in blood pressure.

[1]Read before the Chicago Surgical Society, November 28, 1910. (For discussion see p. 319)

blood pressure 130+, the findings should suggest at once that tihere s intracranial trouble which should demand close observation, preferably by a competent nurse. If the second observation in one or six hours, as the case may be, shows a steady decline—pulse 50, temperature 97, respiration 14, blood pressure 160+, — it is an indication that the pressure is increasing and if not surgically relieved disastrous results may follow.

Third observation—pulse 40, temperature 97, respiration 10–12, blood pressure 200+. A patient cannot live long with such findings. Sooner or later there will be a sudden change in the blood pressure. It drops suddenly to 90−, while the intracranial pressure is found by spinal puncture to remain high, even 200+ or 300+ millimeters of water. Now the time for operative interference has passed and death is the result with or without operation. Spinal fluid pressure remaining high with a sudden diminished blood pressure—(this broken relation)denotes disaster.

Acute extradural abscesses resulting from infections extending from the accessory sinuses, often give an entirely different picture as acute infections have a tendency to increase pulse, temperature, respiration, and often blood pressure. We have here two forces pulling in opposite directions and the result is that often the patient who has had an acute sinus infection with a rise in pulse, temperature, and respiration will suddenly have a normal pulse, temperature, and respiration, but apparently otherwise is much sicker than before. The sudden drop in pulse, temperature, and respiration apparently has been a common deceiver to some of our specialists in otology and has caused them to delay operative procedure, and brain abscesses and death has been the result. Experience has led me to believe that all cases of extradural and brain abscesses that are the result of sinusitis extension belong to the experienced general surgeon. As soon as a patient with acute sinusitis has an increase of pain associated with nausea and vomiting and slow cerebration, there is invariably an extension to the dura irrespective of the pulse, temperature, and respiration and radical surgical interference is demanded. If the infection has extended beyond the dura, localized or diffuse meningitis with the classic symptoms is present and lumbar drainage only tends to increase the area of infection.

In all extradural pressures, lumbar drainage for the relief of intracranial pressure is contra-indicated as only harm can be obtained. Lumbar puncture for diagnostic purposes is always permissible and advisable if done by those competent. If the infection is extradural the examination of the fluid may be negative.

Intradural pressure may be, subdural, subarachnoidal, intracerebral, and intraventricular. To relieve the pressure the dura must be opened, except in the presence of subarachnoid pressure, which may be relieved by lumbar spinal drainage.

The symptoms differ greatly as to location. Subarachnoid hæmorrhage may be associated with weak rapid pulse, slow irregular respiration with elevated, normal or subnormal temperature. Lumbar puncture reveals blood in the spinal fluid and while the patient is unconscious there are at times involuntary movements of groups of voluntary muscles, such as the moving of an arm or leg. The patients are restless and cry out at intervals. For this reason, the site of the lesion is sometimes looked for on the wrong side as the quiet side is taken for the paralyzed side while the irritation to the motor cortex by the blood produces contraction of the opposite arm or leg and the lesion appears to be located on the same side as the apparent paralysis which is never the case.

Acute intracerebral lesions located in silent areas produce symptoms very similar to the extradural lesions and cannot be relieved by lumbar drainage.

Acute intraventricular lesions or internal hydrocephalus cannot be relieved by lumbar drainage for either the foramen or Monro or Ilir or both are closed and the ventricles cannot be drained by drawing fluid from the subarachnoid space. Observations of the pupils and ophthalmoscopic examinations tell us little or nothing in acute cases but are always recommended.

There is one class of chronic intracranial pressure, however, that can be satisfactorily

treated by lumbar drainage. I have been unable to find mention of such cases in medical literature. If similar cases have been reported I would be glad to be informed where the reports can be found.

Recently I have been observing a series of cases that have in most respects a normal mentality. Some resort to petty thievery, others do many things that are contrary to a normal social standing, while others commit grave offenses. They apparently have a conscience but cannot control it. Attempts to discipline them have no lasting results. They may be punished and will immediately commit the same offense for which they were punished. They are bright and active, apt at learning and apparently are normal. Physical and roentgen examinations reveal nothing abnormal, questions are answered intelligently and correctly, until they think it is to their advantage to lie and then it is almost impossible to obtain the facts.

The pulse, temperature, respiration, and blood pressure are normal, there are none of the usual symptoms of intracranial pressure, no headache and no visual disturbances, but the spinal punctures reveal the cerebrospinal fluid under great pressure—from 200 to 300+ millimeters of water registered by the spinal fluid manometer. This may be our only clue that there is cerebral inefficiency. The rapidity of the flow of cerebral fluid from the needle gives absolutely no information as to the intracranial pressure. The pressure is easily reduced by lumbar drainage and remains low for days and perhaps permanently if proper treatment is administered. All laboratory findings are negative except the serological cerebral localization test of Abderhalden as done by Dr. Retinger at the Durand Hospital which invariably reveals in these cases a 2+ and often 3+ reaction of two or more of the glands of internal secretion: the pineal gland, pituitary (posterior), corporus mammilaris (anterior), 2+ or 3+ of the ovaries or testicles, suprarenals, thyroid, and frequently thymus.

The administration of the defective internal secretions will usually prevent the return of the increased intracranial pressure when it is once relieved by lumbar drainage.

As long as a normal intracranial pressure is maintained, by balancing internal secretions by supplying artificially the defective secretion, these patients remain good law-abiding citizens.

It is my opinion that many of our juvenile offenders belong to this class of cases and that our courts should sentence them to laboratories for examination instead of our present day reformatories or schools of crime.

Dr. B. O. Orndoff has furnished me with the following report on the examination of Miss B., one of a series of similar cases.

The examination consisted of roentgen observations of the head, thorax and abdomen, analysis of the blood, spinal fluid and urine together with a consideration of the history and physical findings.

The findings, which seem to have a bearing of importance in her case are in the head, a rather small pituitary fossa and some apparent disproportion of major anatomical structures which are probably developmental and not pathological. The chest is negative; the abdomen negative with the exception of some evidence of fixation of the cæcum and appendix, and the presence of a slightly enlarged ovary on the right side. Findings in the gastro-intestinal tract are negative other than those mentioned. The blood was found under normal pressure and gave a negative Wassermann reaction and no cytological proportions. The spinal fluid registered a pressure of 240 millimeters and decreased as low as 100 millimeters after the removal of 30 centimeters of fluid. The cell count of the fluid was negative as well as the Wassermann and Lange reaction. The physical findings were practically negative.

Dr. Retinger's serological report of Miss B.

The following are the results of the tests on the glands with the blood of Miss B.:

Liver	negative	Ovary	− +
Adrenal	− + −	Thymus	+
Thyroid	+	Spleen	+
Parathyroid	−	Lung	−
Kidney	−	Pineal gland	+
Pituitary (anterior)	−	Pancreas	−
Pituitary (posterior)	− +	Placenta	

It seems that if there is no brain trouble, there must be disturbance in the secretion of the adrenal and the ovaries. They are known to be in a close relation.

Candate nucleus	−	Ant. perforated space	−
Thalamus		Corp. mammillare	+ +
Anterior nucleus	−	Geniculate Lat.	+
Median nucleus	± (+)	Superior Coll.	−
Lateral nucleus	−	Inferior Coll.	± (−)
Putamen nucleus	+ −	Pineal	−
Optic chiasm	−	Pituitary (anterior)	−
Olactory	−	Pituitary (posterior)	+ +
Dura	−	Pons	−
Fornix	−	Medulla	−
Amygdala		Cerebellum	− al
Globus pallidus	−		negative

THE CLINICAL APPLICATION OF THE CARREL-DAKIN METHOD TO CASES OF ACUTE APPENDICITIS REQUIRING DRAINAGE

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UPON the well established foundation of clinical experience in dealing with the less advanced type of peritoneal infection rests the work of Depage in the treatment of certain war wounds. The so-called "abdominal technique" has been applied successfully to the closure of lung and joint wounds as well as extensive wounds of the soft parts after removal of foreign bodies or a resection of contaminated tissues. As in dealing with appendiceal or other intraperitoneal infections, the all-important point to decide has been the degree of contamination or infection. This recent confirmation of the great value of the discrimination between contamination and infection forces upon us in a new light certain considerations which had previously been accepted as a rather inevitable accompaniment of the course of cases of acute appendicitis requiring drainage.

From a review of 263 cases of appendicitis treated at the Presbyterian Hospital during the years 1915–1918,[1] we find that under methods of simple drainage there was a failure in a large percentage (38 per cent) to preserve in a satisfactory manner the very important tissues of the abdominal wall. These tissues at the time of operation are almost without exception free from infection. During the procedure of appendicectomy and drainage of a peritoneal abscess an extensive contamination of the operative wound necessarily occurs. The time has arrived to consider the possibility of preventing this contamination from proceeding unchecked to the stage of destructive infection. It was found in the cases reviewed that the average period of suppuration was 15.4 days, during which time the majority of the wounds discharged foul pus and sloughs. The average duration of hospital stay was 28 days. Among the frequent complications, fæcal fistula developed in 7.5 per cent of the cases. There was a 9.1 per cent mortality. Whether the course of these cases may be improved in any of these essential particulars by the use of antiseptics is dependent upon their safe application and a determination of their efficiency in this type of infection.

As a result of the experimental study of certain chlorine antiseptics in localized peritoneal infections in dogs[2], the antiseptic treatment of cases of acute appendicitis requiring drainage was undertaken first in February, 1918, as a routine in the wards of the Surgical Service at the Presbyterian Hospital.

Aside from the eighteen cases which have been treated by the writer and which form the basis of this report, the method has been employed by others in 13 cases of appendicitis and in a number of intra-abdominal drainage tracts accompanying other conditions.

Before attempting the application of Dakin's fluid to appendiceal infections, the following conclusions had been reached in regard to the considerations involved:

1. Suture material in the intestinal wall apparently is not materially affected by small, repeated injections of Dakin's fluid.

2. Fibrin deposits occur in the presence of Dakin's fluid; adhesions walling-off intra-abdominal drainage tracts may remain effective, and healing of intestinal wounds may occur after repeated injections over a period of several days.

3. Severe pain reactions and shock attend the introduction of Dakin's fluid into the free peritoneal cavity. The use of this antiseptic must, therefore, be restricted to the treatment of the drainage tracts after the period of walling-off has occurred. The injections are, therefore, not intraperitoneal but intra-abdominal.

[1]Rulison, E. T. Jr. Drainage in appendicitis. A review of cases of acute appendicitis requiring drainage, at the Presbyterian Hospital, 1915–1918. Ann. of Surg., 1919, Dec.

[2]Rulison, E. T. Jr. A study of the intra-abdominal use of Dakin's fluid and dichloramine-T solutions with special reference to local peritoneal infections.

4. The satisfactory establishment of a water-tight drainage tract seems to depend as to its rapidity of formation upon the type of infection. The structure of the drainage tract in certain severe infections may be very precarious, even after a considerable interval. Even in the milder infections, a minimum of adventitious tissue is often present between adherent coils. Great caution as to time and manner of introducing the fluid is, therefore, necessitated. Accidents involving the integrity of intra-abdominal drainage tracts, with escape of Dakin's fluid into the free peritoneal cavity, are attended by grave danger, especially if infection be present.

5. Less slough and less foul discharge were noted in the cases treated by Dakin's fluid.

Finally, in some localized peritoneal infections in dogs, Dakin's fluid may be used with comparative safety, provided:

1. Sufficient time is allowed to elapse for a water-tight drainage tract to form;

2. Mechanical pressure of tubes or fluid upon the walls of the tract is avoided.

With these considerations in mind, the antiseptic postoperative treatment was undertaken. At first, Dakin's fluid of half strength was used and the introduction of the solution intra-abdominally was delayed for several days in order that there might be no question as to the establishment of a proper tract. In the later cases, having gained more confidence in the method, full strength Dakin's fluid has been used superficially in the planes of the abdominal wall from the time of operation and after 48 to 60 hours in the deep abdominal drainage tracts.

Attention in the 18 cases reported has been directed especially to the course of wound infection, noting the possible influence of the antiseptic in preserving the abdominal wall tissues, and in altering the course of intra-abdominal suppuration. The bacteriology of the wounds has been carefully studied, especially from the viewpoint of determining whether or not secondary suture of the wounds were possible or feasible. Many cases have in this way received injections for many days after gross suppuration has ceased.

The contrast to the cases treated by simple drainage or by daily irrigation has been sharp, the period of discharge of foul smelling pus with shreds of slough from abdominal wall or abscess cavity in all cases being greatly lessened and in some cases minimized to a striking degree. Although the group is one of fully average severity there have been surprisingly few complications. There have been no fæcal fistulæ. No serious accidents have attended the use of Dakin's solution intra-abdominally, nor have the patients suffered pain reactions following injections, except two late injections in one case. The patients have been discharged with better wounds and the follow-up results to date indicate that the percentages of herniæ will be materially decreased.

DESCRIPTION OF THE METHOD

No essential change has been made in the operative technique of the cases. When possible the stump of appendix has been inverted and the site closed by a purse-string of Pagenstecher, reinforced by a figure-of-eight suture of plain catgut. In the cases with cæcal œdema precluding this treatment, the stump has been crushed and ligated with chromic catgut.

Type and arrangement of drainage tubes. A straight drainage tract is essential. We have not attempted the Dakinization of a curved or tortuous sinus and feel that any attempt to do so would be fraught with danger. A straight tract may always be obtained, e.g., in draining the right lumbar gutter, by insertion of the drains through a stab wound in the loin. In some of our cases with straight and tortuous tracts we have treated one tract with Dakin's fluid and the other by daily irrigations of saline solution.

The selection of the rubber drainage tube is important. We are using a modification of the double arm tube devised by Dr. Joseph A. Blake. The tube is of soft rubber having a wall 2 millimeters in thickness and a lumen of 6 millimeters. Instead of fashioning the tube so that the deep ends of its two arms are held together by a portion of the tube wall, two separate tubes are taken and their beveled deep ends are held together by an

untied loop of plain catgut. One tube is fenestrated by means of a harness punch, the fenestrations being 3 to 4 millimeters in diameter and placed in alternating axes 2 centimeters apart. A strip of narrow gauze packing moistened with 5 per cent dichloramine-T in chloracosane is placed in the fenestrated tube to prevent possible insinuation of a process of momentum, to provide capillarity between the deep end of the tube and the dressings, and for its germicidal effect upon the organisms in the discharge (Fig. 1, A). A long bevel to the deep end of the tubes is desirable permitting a readier collapse of the walls after removal of drain, and lessening the possibility of direct pressure on intestinal walls which are in contact. The non-fenestrated or closed arm is used principally for the purpose of obtaining a larger drainage tract; it also provides freer drainage during the first 48 hours. The drainage tubes must be long enough to project an inch beyond the skin, so that they may discharge into dressings superficial to a thick non-absorbent pad (to be described).

When two drainage tracts are desirable, the double tube may be used in each or a single fenestrated tube with wick used in the shorter tract. We have also employed the single fenestrated tube alone in cases with short tracts (Fig. 3).

Great care should be employed in placing the tubes to obtain a straight drainage tract. This injunction holds good whether antiseptics are to be used or not, but is absolutely essential to the safe employment of Dakin's fluid.

Closure of the abdominal wall. The peritoneum is closed about the tubes with continuous plain catgut. A tight closure is impossible because of the triangular spaces formed by the walls of the tubes and the edge of the peritoneum. These triangular spaces are closed by the introduction of narrow strips of vaseline gauze, the outer ends of which lie upon the skin surface.

The contaminated planes of the abdominal wound are now thoroughly sponged with Dakin's fluid and the transversalis and internal oblique muscles then loosely united about tubes with interrupted plain catgut. The aponeurosis of the external oblique is then closed loosely about the tubes by continuous or interrupted plain catgut, and the skin by angle sutures of silkworm-gut. Untied sutures of silkworm-gut may be placed near the center of the wound.

The skin is now lifted by a small retractor and a 5 centimeter Carrel tube (Fig. 1, D) inserted toward the angle of the wound so that it may lie along the sutured aponeurosis. A second Carrel tube is placed along the aponeurosis toward the opposite angle of the wound. If the wound has been closed in such a manner that the drainage tubes emerge at one angle, but a single Carrel tube, of course, is required.

Separation type of dressing. The employment of the closure just described together with the separation type of dressing is an attempt to prevent the contamination of the planes of the abdominal wall from resulting in an infection and consequent tissue destruction. With this idea in view vaseline strips are placed upon the skin surface, in accordance with the Carrel-Dakin technique, a few gauze compresses and then a Carrel pad, consisting of a layer of absorbent cotton toward the wound and a layer of non-absorbent cotton superficially. The drainage tubes are permitted to extend through this pad and discharge their infectious material into gauze compresses placed externally. The ends of drainage tubes are transfixed by safety pins (Figs. 2 and 5).

The Carrel tubes to the aponeurosis on emerging from the wound lie flat along the skin surface and are held by a strip of adhesive to the skin of the upper abdomen. The ends of these tubes are kept covered by a gauze compress (Fig. 3).

Five cubic centimeters of full strength Dakin's fluid is injected through each of the Carrel tubes before the patient leaves the table, and a similar amount is ordered to be given every two hours night and day.

That the separation type of dressing efficiently functions during the period of its employment (48 to 60 hours) has been repeatedly demonstrated. Foul exudate has been found in the superficial dressings and thin serous exudate with a chemical odor

saturating the dressings in contact with the wound. During this period it would seem that the various re-entrant angles of the wound are permitted to fill with clean fibrin and organization may be well on its way before exudate from the deep tract is permitted to come in contact with the wound.

Postoperative care of wound. First dressing. If operation has been at night the first dressing is done on the following day at 12 to 18 hours; if a morning operation, the first dressing is at 24 hours. All dressings are carefully removed, clean forceps being used in handling dressings beneath the Carrel pad. Fresh compresses and pad are applied. The dichloramine strip is removed from fenestrated tube after application of the fresh pad and smears may be taken from its deep end. A fresh wick of 5 per cent dichloramine-T is introduced into the same tube and 1 to 2 cubic centimeters of the same solution dropped into the closed tube.

Second dressing. If this comes at 36 hours the procedure of first dressing is repeated in every detail. If the second dressing comes at 48 to 60 hours all wound dressings are removed including vaseline strips to peritoneum and the closed drainage tube is also removed. This is best accomplished by grasping it with an artery clamp and loosening it first by a twisting motion, thereby freeing connection by catgut loop to the fenestrated tube. Following its removal the fenestrated tube is loosened and withdrawn about 1 centimeter. It is now trimmed off close to the skin, as separation dressings are no longer used, the deep and superficial wounds freely communicating. Unless there is reason to fear that adhesions have not formed about the drainage tubes (possible in certain cases of acute diffuse peritonitis), a trial injection of saline is made by a small (No. 12 French) soft rubber catheter placed to the depth of the fenestrated tube. With a straight drainage tract, the solution should promptly return *both around and within the tube.* (Fig. 1, B.) Five cubic centimeters of Dakin's fluid warmed to 100°F. is now gently injected. A 10 cubic centimeter Luer syringe is very satisfactory as the fluid is accurately measured and the weight of the plunger is sufficient to

A *A*[1] *B* *C* *D*

Fig. 1. *A*, Modified Blake tube employed at operation for deep abdominal drainage. *A*[1] Cross section of tubing. *B*, Fenestrated arm of modified Blake tube, shortened at outer end and a No. 12 French catheter introduced through lumen; arrangement employed when antiseptic is first instilled in deep abdominal drainage tracts. *C*, No. 18 French catheter employed after removal of fenestrated tube for instillation of Dakin's fluid into abdominal drainage tract. *D*, Carrel tube (5 centimeter type) used for introduction of Dakin's fluid along line of sutured aponeurosis.

cause fluid to run in. If the patient gives the slightest evidence of pain reaction, several hours to a day should be allowed to elapse before again attempting injection. Pain reaction means that the tract is not yet watertight; it means that Dakin's fluid is reaching peritoneum not protected by fibrin. In none of the 18 cases reported have we had a pain reaction at this time. Dakin's fluid warmed to 100° F. is ordered to be injected slowly and gently in 5 cubic centimeter amounts every two hours, all treatment to be discontinued immediately if patient develops a pain reaction. The instillation catheter is left in place, the outer end being held by adhesive strip to skin along with the Carrel tubes. Thus at 48 to 60 hours we may introduce full strength Dakin's fluid (Fig. 6)

even in a deep pelvic tract in such a manner that it may come fully in contact with the infected tract wall. The fluid has exit both about and through the remaining tube. The wound is dressed with vaseline gauze to skin, gauze compresses, and a Carrel pad.

Third dressing and subsequent dressings. It is desirable to remove drainage tubes as early as commensurate with safety. With deep pelvic tracts and severe infections we have maintained the above arrangement and continued the injections by catheter within the fenestrated tube until the fourth or fifth day. In some cases we have substituted a smaller sized fenestrated tube at the third day dressing. When dealing with a short tract, a No. 18 French catheter is introduced on the third day and fenestrated tube removed (Fig. 1, c). This is easily done with no injury to the drainage tract and no discomfort to the patient by introducing it through the lumen of the tube and slipping the latter out over it.

The arrangement of catheters in the deep tracts with Carrel tubes still in the superficial wound is the final one (Fig. 7). No further changes are made until the wound is clinically clean. The dressings from the third or fourth day are extremely simple. The amount of Dakin's fluid intra-abdominally is usually increased rapidly to 10 cubic centimeters. More might be used with safety and perhaps with benefit if infection does not seem to be held in check. We have found that even in a long tract 10 cubic centimeters is amply sufficient to flush it, and that with the 10 cubic centimeters injected superficially the dressings do not become too saturated.

The Carrel tubes are usually forced out by the healing tendency of the wound about the seventh to tenth days. It is not necessary to disturb them. They may be removed, if still in place, as soon as discharge has become negligible.

Sutures are removed at the end of a week. As a rule the reaction about sutures is slight, in many cases not more than is found in a wound healing by primary union. If untied sutures have been placed at operation they may be tied when appearance of wound and bacterial count justifies.

Smaller catheters may be substituted at any time when there is indication that the tract is closing down too tightly about the original instillation catheter. In most cases we have observed this precaution about the eighth or ninth day. The only accident accompanying injection in our cases occurred on the thirteenth day in a deep pelvic tract which fortunately had been clean for at least 48 hours. The walls of the tract had closed down about the instillation catheter and the injection of 10 cubic centimeters of Dakin's was given with perhaps a little more force than usual. The patient suffered a sudden sharp pain in the lower abdomen which continued for over an hour. An injection two hours later failed to return, indicating that the fluid was entering the free peritoneal cavity. The catheter was removed, all treatment stopped, and the patient made a speedy recovery.

Daily bacterial counts have been made in all the cases. While this is not an essential and while the scientific accuracy of the counts may be questioned, we have found them of some practical value. The drop from infinity of organisms usually corresponds closely with the stage of clinical cleanliness when drainage may safely be discontinued. The counts, therefore, aid in a nicer determination of the condition of the wound.

When possible the dressings are done just before a Dakin's injection is due and smears are made either from the deep ends of the wicks in the early dressings or from exudate pressed gently from the wound. Smears from the superficial wound during period of separation dressings have been made and recorded in several cases. These of course are of purely academic interest. Smears taken and recorded for long periods after suppuration had ceased, to determine possibility of safe secondary closure did not indicate that this procedure is feasible.

Treatment of wound after peak of infection has been passed. That secondary closure by suture in the average case is neither feasible nor safe has been a disappointment, but can be satisfactorily explained by the biologic and dynamic conditions present. An abdominal drainage tract represents a dead space, the walls of which as infection declines are lined by granulation tissue. These walls have a very

decided tendency to collapse and obliterate the dead space. In the re-entrant angles of this collapsing cavity micro-organisms may remain in pockets. Sudden increases in the bacterial counts after negative counts for several days indicate the presence of these pockets. While it is theoretically possible that by continued injections of Dakin's fluid the infected cavity might eventually approach nearly enough a sterile condition to permit successful closure of the skin, the time element involved renders such attempts apparently futile. There is a great mass of clinical evidence to prove that residual abscesses rarely occur when drainage is discontinued after suppuration has declined and the wound appears clean. The injection of any fluid, antiseptic or otherwise, into the tract after healing has begun directly opposes the major factor of the healing tendency, i.e., collapse of the surrounding walls. The remaining factors in healing, the shrinkage of tissue and proliferation of new tissue are minor considerations.

In our last cases we removed the instillation catheters and Carrel tubes (if they still remained) just as soon as the wound ceased to show signs of suppuration and bright coral red granulations were in evidence, and applied a dry dressing. The bacterial counts in all these cases showed at this time few if any organisms. All of these cases left the hospital before the twentieth day with wounds healed or with small granulating areas flush with skin surface.

The reader is referred to the case reports and bacteriological charts for detailed description of the technique used under varying conditions.

Tabulation of the 18 cases gives the following data: acute appendicitis with acute local peritonitis was the final diagnosis in 6 cases, *acute appendicitis with abscess in 11 cases*, and acute appendicitis with peritoneal abscess and acute diffuse peritonitis in 1 case.

Intermuscular incision was used in 8 cases, intermuscular with Weir extension in 7 cases, and right rectus incision with splitting of muscle in 3 cases.

The lesions of the appendix found were: acute inflammation with fibrin on surface in 4 cases; gangrenous appendix in 14 cases; perforation of appendix had occurred in 7 cases. Thrombosis of the meso-appendix was noted in 1 case and gangrenous omentum in 1 case.

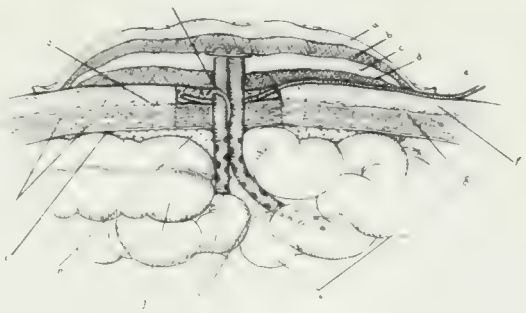

Fig. 2. Diagram illustrating arrangement of tubes and dressings at time of operation. *a*, Pad of absorbent cotton. *b*, Gauze compress layer (outer). *c*, Pad of non-absorbent cotton. *d*, Gauze compress layer (inner). *e*, Carrel 5 centimeter tube to suture line in aponeurosis. *f*, Panniculus. *g*, Aponeurosis of external oblique muscle. *h*, Muscle planes. *i*, Parietal peritoneum. *j*, Cæcum. *k*, Intestinal coils. *l*, Fenestrated soft rubber drainage tubes (closed tube to pelvis not indicated). Fenestrated tube appears too angulated. *m*, Strip of gauze packing placed in angles between tubes. *n*, Omentum. *o*, Sutures.

Free clear exudate was found in 1 case; free cloudy exudate without odor in 6 cases; free foul pus in 2 cases. Localized pus collections were present in 12 cases, in 3 of which the amount exceeded 100 cubic centimeters. Multiple pus pockets were present in 1 case. Foul pus at operation was found in 12 cases. The location of abscesses was as follows: pelvic, 5; subcæcal, 2; procæcal, 1; mesiocæcal, 1; retrocæcal, 1; extraperitoneal, 3 (retrocolic, 2; retrocæcal, 1).

The appendix was removed completely in 16 cases, in 14 of which the stump was inverted and site re-inforced in 13 cases. In 2 cases the stump was crushed and tied off. In one case the appendix had sloughed off near its base and the necrosed portion which contained fæcalith was alone removed.

Cultures were taken at operation in all cases. There were no sterile cultures reported. In 2 cases, however, final culture report was not recorded but in each of these cases organisms were present on smears taken at operation. In the 16 culture reports bacillus coli communis was present 12 times; bacillus coli communior, 1; streptococcus hæmolyticus,

Fig. 3. Appearance of wound at the first dressing. This case was one with a short, straight tract and one fenestrated tube was used. There are two untied sutures near the center of the wound. Carrel tubes are seen entering and pass along the surface of aponeurosis toward either angle of the wound. Their free ends are held by adhesive and the tips are covered by gauze.

1; streptococcus non-hæmolyticus, 2; streptococcus viridans, 1; streptococcus not differentiated, 5; bacillus pyocyaneus, 1; gram negative bacilli, 2.

Double rubber tube drains were used in 11 cases, in one of the cases two sets being inserted and in 5 of the cases an additional single fenestrated tube was introduced. In 4 cases single rubber tubes were used, for the most part cases with abscesses near the operation wound. In 3 cases multiple single tubes were used. No cigarette drains were employed. Drains were placed to pelvis 13 times, to cæcal region 12 times, and to right lumbar gutter 2 times. All drains were introduced through the operative wound.

Closure of peritoneum in a manner to preclude continued contamination of the wound from peritoneal exudate was undertaken in 16 cases. Separation type of dressings was applied in these cases. The only cases in which this part of the technique was not employed were the first case of the series and one case in which particularly free drainage was thought desirable because of the widespread infection present.

Skin closure was loose in 17 cases. We had cause to regret the snug closure in the remaining case. The aponeurosis of the external oblique was included in the skin suture in 3 cases, 2 of which were ill advised. The one case in which the procedure was perhaps justified was one with a long right rectus incision and with marked distention of intestines. Untied sutures were placed in skin near the center of the wound in 4 cases.

Carrel tubes were placed along the aponeurosis in all cases.

RÉSUMÉ OF POSTOPERATIVE WOUND TREATMENT

Early replacement by smaller drains, or removal of the closed tube arm was carried out in all cases, the average time for this maneuver being 2.6 days.

The average time at which instillation catheters alone were present in the drainage tract was 4.5 days.

Of the 27 tracts present in these 18 cases all but 4 were treated by Dakin's fluid. Two of these were tortuous and in 2 the drains were removed early without replacement.

Dakin's fluid was used on an average of 9 days in the superficial wounds, the average amount being 10 cubic centimeters every two hours.

The average time at which Dakin's was first introduced into the deep drainage tract was 2.7 days (65 hours) from time of operation. The average time when Dakinization of the deep tracts was discontinued was 13.6 days after operation. The average duration of the deep antiseptic injections was, therefore, 11.2 days. The amounts of Dakin's fluid used varied from 2 to 10 cubic centimeters. In all cases except the first, 2 full strength Dakin's was used and 5 to 10 cubic centimeters in each tract was the customary amount.

Antiseptic treatment of the deep tracts was abruptly discontinued because of complication in 3 cases: the first (Case 3) on the tenth day because of indications of residual abscess; the second (Case 7) because of mechanical ileus; the third (Case 9) because of accident to drainage tract during injection on the thirteenth day. *Vide supra.*

Five per cent dichloramine-T was used at operation and during the first 48 hours in 15 of the cases.

There was evidence of insufficient drainage in but one case (Case 3). On the tenth

Fig. 4. The same wound as in Figure 3 with vaseline strips laid on the skin surface and a single gauze compress placed about the tube.

Fig. 5. The same as Figures 3 and 4, with Carrel pad applied. The drainage tube is allowed to project through this pad of absorbent and non-absorbent cotton and discharges into the superficial gauze compresses which are applied and held by the taped adhesive straps which may be seen turned back.

day signs and symptoms of residual abscess developed. Dakin's injections were discontinued. Measures to relieve condition were unnecessary as the wound shortly spontaneously discharged a quantity of exudate.

The re-institution of drainage was not necessary in any of the cases nor were measures to improve drainage necessary.

The average time when all treatment was stopped and dry dressings applied was 13.8 days.

There was no gross suppuration present in one case, slight suppuration in 5, moderate suppuration in 7, and profuse in 5.

The discharge was odorless throughout in 2 cases. The average duration of odoriferous discharge in 15 cases was only 6 days, and in a number of cases the odor was slight.

Seven cases passed through their period of drainage without apparent slough; in 8 cases the slough was superficial or from the deep tract (abscess wall); in 3 cases only was there definite slough of aponeurosis, and in 2 of these the slough was what would ordinarily be considered slight. The one case in which the aponeurosis suffered considerable damage was Case 7. In this case the aponeurosis was included in the skin sutures and Dakinizatson of the superficial wound was thereby rendered inefficient.

There were no cases of disruption of the wound, and but one (Case 7) in which real wound infection occurred. In no case did the intestine herniate into the wound.

Bacterial counts ranged below 60 per field throughout in 4 cases. In 13 cases the counts remained at infinity until the eighth day (average) when a drop in the number of bacteria occurred. The earliest drop from infinity was the third day and the latest drop the twelfth day. The drop was rapid and abrupt in some cases and slow in others.

The average time when suppuration ceased and wounds were entirely free of slough and lined by bright red granulations, with bacterial counts low was 10.9 days (16 cases treated throughout by antiseptics). The 2 cases excluded are Case 7, with mechanical ileus interrupting treatment on sixth day, and Case 12, death on fourth day.

Closure of wound by suture was attempted in 5 cases with 3 successes and 2 failures. Gradual closure aided by strapping with adhesive has been the rule, and has proved the most safe and practical method in our hands.

Certain complications were in a way anticipated, as we were proceeding in an untried field. While the early introduction of Dakin's fluid in the local peritoneal infections of the dog gave us a certain degree of assurance, the reaction of the human peritoneum was an unknown factor that could only be determined by careful trial. That Dakin's

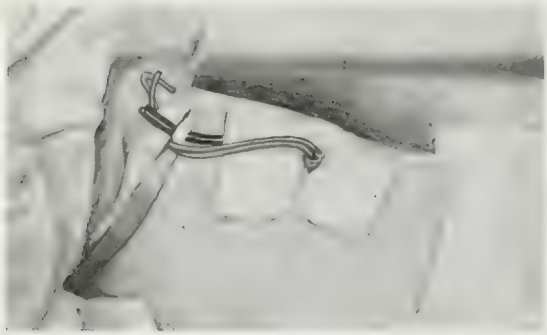

Fig. 6. Case having two drainage tracts (cæcal and pelvic). Arrangement of tubes at end of 48 hours. The closed tube to the pelvis has been removed and the fenestrated tube loosened and shortened. Trial injection by catheter seen entering end of tube has been made. The cæcal tube (one only) has been loosened and shortened and an instillation catheter introduced. Carrel tubes to superficial wound appear emerging from gauze compress.

fluid did not destroy protective adhesions, that suture material imbedded in tissue was not acted upon in any serious manner, that secondary hæmorrhage and fistula did not result from its use was very soon established. In these 18 cases there has not been a single case of secondary hæmorrhage or fæcal fistula. There has been but one residual abscess which emptied itself spontaneously through the drainage tract.

The only serious complication of the series was a mechanical ileus, which was probably due to tube pressure. In this case a single tube of unusually large lumen and very thin wall was placed to the pelvic abscess. The end of the tube was not properly beveled, and to prevent possible buckling the lumen was filled out with more gauze than is advisable. At operation on the sixth day an angulated loop was found in the pelvis in a position indicating possible pressure from the drainage tube. The condition of the tract was found unusually clean for the sixth day and the case made an uninterrupted recovery. Dakin's was not used after the operation for relief of ileus and there was considerable wound suppuration, resulting in a ventral hernia.

There were two pulmonary complications, one an acute bronchitis, the other a probable pulmonary embolism occurring in the one fatal case. The patient (Case 12) was a very obese woman, age 50, with a gangrenous perforated appendix, free foul pus in poorly localized collections through lower right abdomen-visceral peritoneum covered by thick fibrino, purulent exudate. The omentum fully 5 centimeters in thickness was acutely inflamed. That her resistance was unusually low was indicated by a low leucocyte reaction after more than 48 hours of infection. (White blood cells 7,400, polymorphonuclears 78 per cent.) Following operation her abdominal condition was apparently improving, when on the fourth day she became dyspnœic, cyanotic, face flushed, and heart action irregular. Her cough was unproductive. Fine moist crepitant râles were heard at both bases. Death occurred 102 hours after operation. Unfortunately no autopsy was obtained. In this case separation dressings were not employed. Dakin's fluid was introduced in the deep tracts after 48 hours, with free return and no pain reaction.

The condition of wounds on discharge was as follows:

Healed 2 cases; healed with clean crust 2; small granulating areas flush with skin surface 6; large granulating area (0.5 by 2 centimeters) 1; with shallow sinus 6. There was only one case discharged with a weak wall (Case 7 Dakin's treatment interrupted by development of mechanical ileus).

The average duration of hospital stay was 24.1 days. During the developmental period of the technique, several cases were Dakinized for longer periods than routine practice would demand.

Sixteen of the 17 recovered cases have been followed up over a period of 2 to 6 months. There have been no symptomatic failures indicating untoward late peritoneal changes (adhesions) and no economic failures. Unfortunately the exact time of resuming work or play has been recorded in but 3 cases. One of these was a child who resumed full play on reaching home, the other 2 resumed work at the end of 3 weeks after leaving hospital. The anatomical results were excellent in 12 cases (75 per cent); there was a slight bulge present in one case (rectus incision) at 6 months and a diffuse bulge at 2 months in the child referred to above; there were 2 hernias (12.5 per cent), one small

and one large, the latter occurring in case not Dakinized throughout.

There have been no late secondary complications or operations.

While 18 cases represent a small series it comprises infections of fully average severity and the results show a decided improvement in many respects over those attained under simple drainage treatment, when comparison is made either with the 263 cases reviewed[1] as a whole or the cases handled by any one of the various methods employed by individual operators (Table I).

Dakin's fluid and dichloramine-T solution have been used by several surgeons at the Presbyterian Hospital in the treatment of their cases during the past few months. In this early period of the use of antiseptics intra-abdominally we have all endeavored by various means to render the method of their use as simple as possible. The author is indebted for many valuable suggestions to the experience of other members of the staff who have employed Dakin's fluid in the treatment of their cases. A review of the 13 other cases of appendicitis in which antiseptics were employed shows no serious complication attributable to the method. Fæcal fistula occurred in 2 cases, one thought to be due to prolonged pressure of the drainage tube; the other occurred at the twentieth day. Hæmorrhage occurred from a right rectus wound in one case. Two secondary abscesses developed, one mural and one peritoneal. There was one death. The average duration of hospital stay was 24.1 days. As most of the cases have been recent ones the follow-up results are incomplete.

Fig. 7. Same as Figure 6, with cæcal and pelvic tracts. The drainage tubes have been removed leaving No. 18 French catheters in the two tracts. One of the Carrel tubes has been forced out by rapid closure of the upper angle of the wound. Untied sutures may be seen knotted and strapped back.

The following observations have been made in the cases treated by others when favorable expectations were not being realized:

1. That Dakin's fluid was not begun in the superficial wound until the third or fourth day.
2. That insufficient amounts of Dakin's fluid were used (1 to 2 cubic centimeters) both superficial and deep.
3. That injections have been given at infrequent intervals, every 3 to 4 hours,

[1] Drainage in appendicitis. Ann. Surg., 1919, Dec.

TABLE I

	263 cases reviewed	Best results attained under methods of simple drainage			Antiseptic treatment Author's 18 cases
		A_1 (30 cases)	B_2 (28 cases)	C_3 (20 cases)	
Period of suppuration	15.4 days	13.5 days	15.6 days	13.8 days	10.9 days
Immediate secondary procedures (to improve drainage, etc.)	16.4 per cent	3.3 per cent	10 per cent	20 per cent	5.5 per cent
Fæcal fistula	7.5 per cent	10 per cent	0 per cent	0.9 per cent †	0 per cent
Duration of hospital stay (initial)	20.5 days	22.7 days	23.4 days	29.9 days†	24.1 days
Perfect anatomic, symptomatic, economic results	58 per cent —*	53.4 per cent	57.1 per cent	63.7 per cent	75 per cent
Weak walls	per cent per cent	per cent per cent	per cent per cent	per cent per cent	per cent per cent
Bulges	18	20	14.3	22.7	12.5
Herniæ	20 — 38	26.6 46.6	28.6 42.9	13.6 36.3	12.5 25
Deaths	9.1 per cent	3.3 per cent	3.6 per cent	3.4 per cent	5.5 per cent

A_1—Cases were treated by cigarette drains, later removal, few irrigations.
B_2—Cases were treated by early replacement of tube drains by catheter and daily irrigation.
C_3—Cases were treated by early loosening and shortening of tube drains, with irrigation, late replacement of drains by smaller tubes.

* In 4 per cent condition of abdominal wall could not be determined from the records.

†There were 5 secondary procedures in one case, making total unusually high; 2 fæcal fistulæ in 1 case; one case remained in hospital 205 days. Average duration of hospital stay with this case excluded-23.2 days.

or discontinued entirely while patient was sleeping.

4. That drainage tubes have been left *in situ* for 5 to 7 days and Dakin's fluid given only within the tubes allowing little or no contact of antiseptic with wall of tract.

5. That Carrel tubes for protection of aponeurosis have been improperly placed:

a. Wound sutured too tightly about these tubes, making injection difficult and forcible injection causing dissecting up of the loose tissues.

b. Tubes introduced from the angles of the wound rather than the center, with gaping of wound resulting after a few days.

While unremitting care and attention to essential details are absolutely necessary in the antiseptic treatment of these cases, it is the author's conclusion that Dakin's fluid may be used with safety and with far better immediate and probably better remote results than may be attained by simple drainage.

While it is not within the scope of this report to enter into a discussion of the exact manner in which a 0.5 per cent neutral sodium hypochlorite solution may act as an antiseptic, certain clinical observations and perhaps speculations may be of interest. It does not seem too much to hope that with the proper introduction in adequate amounts of this or some other antiseptic the vitally important tissues of the abdominal wall may be completely preserved in all cases by preventing the stage of contamination from passing to one of infection. This, in the author's opinion, is the major part of our problem. The abdominal drainage tract in these cases within 48 to 72 hours represents a limited infected dead space, the walls of which are lined by fibrin, leucocytes (dead and living) and bacteria. The structure of the walls of the tract is in all cases a delicate one and as the coils of intestine may be united by minimal adhesions, gentle treatment is entirely essential if antiseptics are to be introduced. The tensile strength of the drainage tract as treatment continues, probably decreases rather than increases. The introduction of an antiseptic having the known irritant properties of Dakin's fluid within the general abdominal cavity must always be done under low pressure and with certain and unimpeded return into the wound dressings. While the degree of infection in the dead space of the drainage tract must increase rapidly during the first 48 to 60 hours after operation, delay of introduction of this antiseptic during this period seems necessary from the viewpoint of safety. During this period when adequate antiseptic treatment of the deep tracts seems precluded the discharge of pus into dressings not in contact with the wound and the attempt to minimize the infectivity of the issuing exudate by dichloramine-T strips within the drainage tube seems the most rational and safe procedure. An antiseptic necessarily must have actual contact with infected tissue in adequate quantity, and this may be accomplished 48 to 60 hours after operation by removal of one or both tubes, the fluid being introduced by catheter, placed to the depth of the tract. Just what Dakin's fluid introduced in 10 cubic centimeter amounts into these tracts accomplishes may be debated from many angles. A thorough mechanical flushing of the tract with fluid during the period of active infection may be credited with at least removing the detachable products of infection. We know that the infected fibrin lining the walls of the dead space eventually comes away in fragments or extensive sloughs, leaving the wall lined by clean granulation tissue. It has been claimed that Dakin's fluid causes a rapid disintegration of necrotic tissue. Our experience has been unqualifiedly in favor of this assertion, certain of the cases with definite necrotic abscess wall at operation healing without the discharge of macroscopic slough. Whether Dakin's fluid is actively germicidal, whether by its slight irritant nature more phagocytes are attracted to the infected locality, are questions of interest but rather indeterminable in a clinical study. Whether the action of the antiseptic in killing bacteria outweighs its destructive action on phagocytes, or whether the favorable outcome of wounds treated by Dakin's fluid is brought about despite the antiseptic rather than by reason of any inherent virtue are academic questions. Some investigators give the credit to the bactericidal influence of

the antiseptic; others to the phagocytic activity which goes on during the intervals between the injections. Whatever may be the action of the Dakin fluid, our results seem to indicate that, with continued flushing with 5 to 10 cubic centimeter amounts at 2 hourly intervals, these tracts cease to discharge pus and are lined by a clean granulating wall at an earlier period in the average case than when treated otherwise. When the period of suppuration has passed, the biologic-dynamic considerations of a clean dead space seem to favor immediate cessation of all treatment in order that wound healing may be most favored. Partial secondary suture (suture of the angles of the wounds) may aid in hastening closure; complete secondary closure will probably be disappointing.

There is one consideration which may be of greater importance than has been generally realized, namely the influence of the infection curve in the less resistant tissues of the abdominal wall upon the curve of infection in the tract lined by highly resistant peritoneum. It is conceivable that the rather large group of cases that surgeons drain when in doubt have their course greatly protracted by retrograde infection from the superficial portion of the wound. All dressing procedures, loosening, or removal and replacement of drains favor this contamination of the deep tract. Thorough antisepsis of the superficial wound with care in replacement of drains within the lumen of existing drains is well worthy of attention, whether or not one wishes to accept the responsibility of introducing an antiseptic into the intra-abdominal drainage tract.

In conclusion emphasis should again be laid upon the necessity of thoroughly mastering the details as well as the principles underlying the introduction of such antiseptics as Dakin's fluid into deep, infected abdominal drainage tracts. While a single accidental admission of 5 to 10 cubic centimeters of Dakin's fluid through an infected tract into the free peritoneal cavity would probably not result fatally, it would certainly be productive of intense pain and alarming symptoms. We believe that the probability of such a complication is slight if the treatment is carried out along some such precautionary lines as have been found safe in our cases. If one is not willing to give the time necessary to gain a correct theoretical understanding, and is not willing to give the cases his careful, personal attention at daily dressing, the method should not be employed as it will probably not only prove disappointing, but may result in serious complications.

DEPARTMENT OF TECHNIQUE

THE PROTECTION OF THE SKIN FROM PUS, URINE, FÆCES, CHEMICALS OR ANY OTHER IRRITATING MATERIAL BY THE USE OF SHEET RUBBER ADHERENT TO THE SKIN

By ANGELO L. SORESI, M.D., New York City

THE fact that the skin needs protection against prolonged contact with pus, urine, fæces, chemicals and any other irritating material, is as well known as the fact that an efficient protection is very difficult to obtain and that some patients have suffered more on account of the irritation of the skin following a suprapubic prostatectomy, or a pleurotomy, or the use of chemicals intended to sterilize some wounds, than on account of the original disease itself. We have been very successful in protecting the skin by adopting the following plan. Before the operation the intended line of incision is marked out, the skin is cleaned and dried with ether and painted with a solution of rubber cement dissolved in about five parts of ether, for about 2 centimeters all around the intended line of incision. To the skin so prepared is applied a piece of sheet rubber of sufficient size to cover the area of skin that might later come in contact with the irritating material. The sheet rubber is gently compressed against the skin, as it is done when a patch is put on a rubber glove, on a tire or any other rubber material. The surgeon then makes the incision in the usual manner, obviously first cutting the sheet rubber, then the skin and then the deeper structures. Along the line of incision the sheet rubber will have adhered to the cut edges of the skin, so that no material that could come out of the wound would

Fig. 1. Sheet rubber applied previous to the opening of the urinary bladder. *A*, Sheet rubber applied over the area of the skin that might become wet and irritated by the urine. Note that the sheet rubber covers completely the genitals. *B*, Dotted line shows how far from the intended line of incision the skin should be painted with the ether rubber solution. *C*, Incision through the sheet rubber.

Fig. 2. Sheet rubber applied in cases of empyema. *A*, Sheet rubber. *B*, Dotted lines show the extent to which the sheet rubber should adhere to the skin, which has previously been painted with rubber ether solution. B^1, Shows adhesion of the sheet rubber to the skin above, so that the same should not fall if the patient should stand up. *C*, Incision through the sheet rubber.

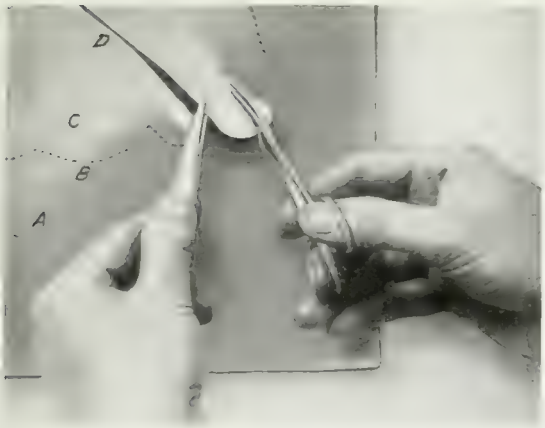

Fig. 3. Sheet rubber applied in cases of large wounds. *A*, Sheet rubber. *B*, Dotted line showing attachment of the sheet rubber to the skin. *C*, Contour of the wound *D*, Line showing the sheet rubber cut in the middle, so as to allow its trimming along the contour of the wound with the help of thumb forceps that raise up the edge of the sheet rubber and scissors cutting very close to contour of the wound, as shown in Figure 4.

Fig. 4. *A*, Sheet rubber. *B*, Dotted lines showing attachment of sheet rubber to the skin. *C*, Wound with sheet rubber well trimmed around its contour.

ever touch the skin, which in this manner is completely protected from the contact with any irritating material. Illustrations show how sheet rubber is applied in different cases.

Precautions in the application of the sheet rubber. We have stated that the line of incision can be marked before applying the sheet rubber; this step, however, can be omitted, if the sheet rubber is rather thin, because through it all the structures and landmarks can be seen and felt very easily.

The application of the sheet rubber must be made so as to have the rubber adhere well to the skin. For the ones accustomed to patch rubber goods any advice is unnecessary, because the film of rubber that is left on the skin after the application of the rubber ether solution, makes the adhesion of any rubber material to it subject to the same rules that govern the adhesion of any patch over rubber material. In any event the precautions to be taken are: the skin must be dry before the application of the rubber ether cement, which must be perfectly dry and clean; the sheet rubber must be compressed against the skin so as to make it adhere completely without any air under it; if the ether cement solution is very thin, it is better to apply two or three coats of the same before applying the sheet rubber.

If the solution of ether and rubber has been allowed to stand some time and the sheet rubber is sterilized, the surgeon can cut through the sheet rubber without any previous preparation of the skin with tincture of iodine, because the wound will positively not be infected by the incision, after the skin has been protected with rubber ether cement. As explained in another paper,[1] we strongly deprecate the use of tincture of iodine previous to the painting of the skin with the ether rubber solution and the application of the sheet rubber which, we repeat, are sufficient to protect against infection.

When the surgeon has to deal with an open wound, such as the one shown in Figures 3 and 4 the procedure is the following: the skin around the wound is cleaned and then dried with ether; rubber ether cement solution is applied for about 2 centimeters around the wound; sheet rubber is applied over the whole wound, which can be filled, if deemed necessary, with sterile dry gauze. The sheet rubber is compressed against the skin; the sheet rubber is cut in the middle and trimmed all around the wound.

The sheet rubber must be of good quality; dentist dam is the best; common rubber tissue is too brittle.

If the skin needs only to be protected for a few days, the rubber cement ether solution applied rather thick, will be sufficient.

We advise having the sheet rubber adhere to the edge of the wound only for about 2 centimeters all around it, because obviously there would be no advantage in having all the sheet rubber adhere to the skin.

[1] Soresi, A. L., The preparation of the skin for operation with solution of rubber and ether instead of tincture of iodine. Ann. of Surg., 1920, Jan., p. 109.

AMPUTATION OF THE HIP-JOINT WITH REMOVAL OF THE WHOLE BONE, AND FLAPS AMPUTATED JUST ABOVE THE KNEE

By GASTON TORRANCE, M.D., Birmingham, Alabama

ABOUT two years ago a man, 30 years of age with a long standing tubercular condition of the whole thigh bone and also of the knee-joint, was referred to me for amputation at the hip. He had had the disease in some part of his leg since childhood and was very much emaciated and was quite toxic. An X-ray was made of the joint and showed destruction of the head of the femur with an ankylosis of the hip by means of an outgrowth of bone across from the trochanter to the ischium which flexed the thigh on the pelvis and drew it inward. He was a very poor subject for any kind of an operation and especially for a hip-joint operation.

Under ether anæsthesia I made an incision over the trochanter and down the thigh almost to the knee and removed the head of the bone and chiseled loose the bony connection with the pelvis and curetted out the acetabular cavity. The shaft of the bone was so much diseased that as soon as the head was gotten out, it broke in two just below the middle of the shaft and was removed. I then dissected out the femoral artery and ligated it with heavy catgut, without at any time during the operation using a tourniquet or any other means of controlling hæmorrhage. Up to this time the patient had not shown any symptoms of shock. With a large knife I now severed the fleshy part of the thigh just above the knee, and closed the flaps just as though it were an amputation at the knee-joint.

There was very little shock and the patient made a rapid recovery. He is now in perfect health and has a good firm stump (muscular). The photograph was made about a year after operation and shows him to be in better health than he has been in years.

I see the patient constantly and he is well and seems much pleased that he has a stump left.

EXTERNAL SURGERY OF THE NASAL ACCESSORY SINUSES[1]

By CORNELIUS G. COAKLEY, M.D., F.A.C.S., New York, and W. W. PEARSON, M.D., F.A.C.S., Des Moines, Iowa

IN external surgery of the nasal accessory sinuses, especially of the fronto-ethmoid group, we are confronted with two problems:

1. The division of the cases into those which are best approached by the external route, rather than by the intranasal.

2. The selection of operation which gives the most satisfactory end-results.

Let us first consider what cases demand external operative procedures. A discussion of this subject among those who have had a large clinical experience in the treatment of acute and chronic infections of the fronto-ethmoid sinuses, would probably result in a wide difference of opinion as to the value of intranasal or external operative procedures in any given class of cases. My own experience during the last 10 years is that it is possible to relieve or cure many more cases of fronto-ethmoidal disease by intranasal operation than I did in the preceding decade. The number of my external operations on the fronto-ethmoidal sinuses has diminished greatly during the past 10 years. Unquestionably bolder and more thorough intranasal removal of the anterior group of ethmoid cells, thereby establishing better drainage through the naso-frontal canal, and the teaching of a patient to pass a cannula into the frontal sinus for the purpose of irrigation, has cured many patients who I formerly thought could only be cured as a result of external operation.

As evidence of this during the past 11 years we have diagnosed 273 cases of frontal sinus disease, diagnosis having been confirmed in each case by roentgenograms. Of this number only 7 were required to have external operations. Of the total number of fronto-ethmoid cases operated upon by me 11 were patients who had been operated upon by surgeons and presented themselves after one or more operations with fistula, as evidence of the failure of the operation to eradicate the disease and secure the desired relief. Eliminating, therefore, these secondary operations, the percentage of cases requiring external operations is seen to be extremely small, viz., 13.5 per cent. It must not be inferred that the intranasal operation invariably cures the patient, if by cure one means complete cessation of all discharge, and the absence of more or less periodical recurrence of an acute process in the sinuses. So long as a patient has a frontal sinus that has been the seat of a chronic infection, it is possible for reinfection of that sinus to take place. If, however, the patient can be taught to irrigate his own sinus, or by a few treatments on the part of a rhinologist, can be relieved of his pain or discomfort, and brought back to a practically non-secreting condition of the mucous membrane lining the cavity, that patient will, in all probability, be satisfied with the result, rather than undergo more or less deformity as a result of an external operation. Orbital cellulitis, spontaneous fistula from the rupture of the anterior or inferior wall of the frontal sinus, presence of new-growths within the sinuses, patients whose symptoms persist in spite of attempts to establish satisfactory intranasal drainage, and those who cannot give the time to or refuse intranasal operations, are the only cases which, in our opinion, require external operation.

The most logical type of external operation on the frontal sinuses is that which was recommended by Killian some 17 or 18 years ago. Since it was first advocated various modifications of it have been suggested with a view of minimizing the deformity. The object of the Killian operation is the ablation of the entire infected mucosa and the obliteration of the cavities, thereby preventing future infections and recurrences.

The failures resulting from the performance of this operation that have come under my notice have been invariably due to the fact that the operator has left some portion of the mucous membrane in some but partly exposed part of the sinus. We have met with two types of imperfect operation: One is that in which the overhang has been left in the upper portion of the anterior wall, the operator being satisfied that he was able to remove thoroughly all the membrane underneath the overhang. If one examines many frontal sinuses he will easily see that this is a most dangerous procedure, because occasionally a little portion of the frontal sinus will extend upward through a small inlet and then expand out into a fairly good sized cell. This offshoot of the sinus is almost certain to be overlooked if any overhang is left. The other and more frequent source of failure has been the presence of a cell situated beneath the horizontal portion of the frontal

[1]Presented before the Clinical Congress of American College of Surgeons, New York, October 22-24, 1919.

bone, at the external portion near the external angular process of the frontal. This cell, or rather a prolongation from the ethmoid cells, may be entirely unsuspected unless it is most carefully looked for after widely opening and cleaning out the frontal sinus. A probe bent at right angles and passed externally from the naso-frontal canal parallel to the supra-orbital arch one-half inch below the arch, will usually find this cell. The anterior wall of this cell is usually flush with the posterior wall of the frontal sinus. The cell extends laterally beyond the outer margin of the vertical portion of the frontal sinuses. This cell is often overlooked when exenterating the ethmoidal labyrinth because it extends so far externally over the roof of the orbit. It often has a septum which runs anteroposteriorly over the roof of the orbit, and has but a small communication with that portion of the ethmoid labyrinth that is on the inner side of a line drawn to the middle of the orbit. Of 11 secondary operations performed during the last 11 years, every one of them had this large cell underneath the vertical portion of the frontal sinus. Roentgenograms of the frontal sinus do not always indicate the presence of this cell owing to the narrowness and to the dense frontal bone overlying it. The mucous membrane lining this sinus oftentimes fails to manifest much trouble for several years, until the engrafting of a fresh infection causes an increase in the secretion. Dense cicatricial tissue prevents the secretion from following the line of least resistance into the nose, and the swelling of the scar or upper lid, the evacuation of pus externally, is the eventual common history.

I would recommend for consideration a slight modification of the Killian operation that we have been doing since 1907, namely, separating the incision for the exposure of the vertical portion of the frontal sinus, and that for the ethmoid labyrinth. The former incision begins at the median line and extends in a slightly curved direction parallel with and just above the upper margin of the eyebrow, out to the very outermost portion of the external angular process of the frontal. The incision is carried directly down to the bone, the periosteum elevated above as far as the roentgenogram indicates the height of the frontal sinus, and the periosteum peeled downward one-eighth of an inch. This incision enables one to remove the entire anterior wall of the frontal sinus and to bevel the upper margin, so that there is no abrupt or rough margin for the periosteum to fall over on.

The incision for the ethmoid labyrinth is started one-quarter inch external to the supra-orbital notch, and about three-eighths of an inch posteriorly to the junction of the vertical and horizontal portions of the frontal bone. It is carried in a slightly curved direction downward, midway between the inner canthus and dorsum of the nose, down along the side of the nose to the inferior border of the nasal bone. From this incision the periosteum is reflected anteriorly and posteriorly elevating the pulley of the supra-oblique along with the periosteum. Through this incision ample space is given for exenteration of the ethmoid labyrinth, including the sphenoid cavity, and particularly making it possible to follow up all the cells of the ethmoid which extend laterally over the roof of the orbit, and which at the outer angle frequently communicate with the vertical portion of the frontal sinus, as heretofore described. The double incision has an added advantage in that one may readily coapt the wound without that puckering which is so frequently obtained in the single Killian incision, and permits one to remove the dressing from the ethmoid incision on the third day, while keeping up pressure by the bandage over the skin, of the frontal sinus so that there is little likelihood of infection taking place by way of the nasal passages.

Of the 35 cases upon which I operated primarily, three had recurrences, one at the end of two years, and the second recurrence seven years later. One operated on in 1904 had a recurrence in 1918. One operated on in 1910 had a recurrence in 1919. Of 11 cases operated upon by other surgeons and by me secondarily, none of them thus far has had a recurrence. Of the total 46 patients operated upon, 3 died; one operated upon in 1914 left the hospital apparently cured, when 3 weeks later he suddenly developed intense headaches, nausea, and vomiting; was admitted to the hospital and seen about 2 p.m. when he was in coma. Arrangements were made to operate upon him about 5 p.m. but he suddenly died with all of the evidences of what we took to be a rupture of a frontal lobe abscess into the lateral ventricle, which findings were confirmed by autopsy. The patient operated upon in 1908 died last fall during the epidemic of influenza, of pneumococcus meningitis. Examination of his nose the day before he died failed to show any evidence of sinus disease. The third patient, operated upon in April, 1918, died during the summer of 1919, cause unknown.

DISCUSSION BY W. W. PEARSON

From the beginning of my work in this line my tendency has been toward conservation; my first thought has always been to relieve the patient with as little operative work and display of interference as my judgment would permit. For this reason I have made use of the intranasal route rather than opening up externally with the resulting scar.

The submucous resection of the septum has aided me very materially in relieving sinus troubles through the intranasal route.

There are, however, types of cases that demand immediate operation and in the hands of most of us, the external operation is the safer. I refer especially to cases of sinus infection in which the interior of the nose is so disturbed through accident, unusual developmental defects, or severity of infective process that immediate action to save the life of the patient is demanded. I recall, for example, the case of a student whom I saw late one night with a temperature ranging from 104 to 105°, and delirious. It was his first experience with a frontal sinus infection. Following a Killian operation which revealed a sinus completely filled with a serosanguinous fluid, the relief was immediate and healing took place within a very short time.

An unfortunate feature in connection with the intranasal operations is that the irregular nose which usually means impaired drainage, is the nose more often subject to the sinus infection; naturally this means greater difficulty in operating intranasally.

In cases of orbital abscess secondary to nasal sinus infection, I have always felt that thorough drainage is so imperative that the external operation has been my selection.

As a student I learned of Professor Langenbeck's unfortunate removal of an eye. He operated under the impression that he was dealing with a new-growth, only to find an abscess the draining of which would not have necessitated the removal of the eye. I am not so sure that, in exceptional cases, the removal of the eye is not necessary.

Last summer a young man came under my care who gave a clear history of frontal sinus infection covering a period of 3 or 4 months; an orbital abscess complicated the condition. Evidently he had been desperately ill as he had no recollection of several weeks of the period of illness. Being on a farm in a remote section of Canada, the attending physician removed his eye and drained the abscess in a manner that probably saved his life. When I saw him he continued to carry a temperature and the orbital structures were in such shape that it was necessary to clean out the frontal and ethmoidal cells and do a little plastic work on the lids to permit the wearing of an artificial eye. The loss of the eye in this case was deplorable, but if I have the situation pictured correctly, this man owes his life to the practitioner who was not a specialist but who did recognize the importance of drainage even at the expense of an eye.

In discussing orbital abscess which, when present, has for its origin so often an infection of one or more of the nasal sinuses, I feel that the discussion would be incomplete if I did not mention the possibility of having to deal with blood cysts of the orbit, as pointed out by Doctor Gifford, or a chloromatous mass as was a recent experience with me; the latter case I saw last June.

A boy of about 12 years was referred to me because of a marked proptosis on one side. An examination of the nose revealed an organ regular in its makeup and free from any suggestion of sinus trouble; the X-ray indicated no sinus involvement; the blood examination, fortunately, showed a chloromatous change. This induced me to refrain from operation and later watch the development of the chloromatous condition with the invariable result — death.

The healing of a chronic nasal sinus empyema differs greatly from that of the acute condition, although I must admit that my judgment has often gone wrong in the prognosis of the latter. For example, of two cases which, according to their history had been active several months, the one healed with drainage within two weeks, whereas the second, while causing no apparent trouble other than that resulting from the drainage, still offers no promise of recovery.

Shall we operate upon all the chronic cases which refuse to heal under the usual careful attention? To define more clearly the latter group, I mean those giving rise to no constitutional symptoms but presenting more or less always the proof of their presence by the drainage in the nose. This question, I believe, can only be answered after explaining the condition to the patient and securing his decision. The ideal would be to restore every tissue to normal and do away with all infection. This sometimes entails extensive operations which are no doubt necessary in individual cases but should be avoided when possible.

The chronic cases giving rise to pressure symptoms or evidence of absorption must be operated upon when a sinus is large and filled with granulation tissue and pus. I recall a frontal sinus case operated upon by me several years since, the sinus measuring a little more than 12 centimeters, extending from the left external orbit across the forehead — I do not recall the exact depth, but it was exceptional; it was filled with the results of chronic inflammation — this

represents one extreme involvement. The sinuses not filled up with the results of chronic inflammation but secreting a thin mucopurulent fluid draining into the nose, represent the other extreme. The former demands radical operation; the latter occupies a place in the debatable field.

Several years since in conversation with a friend who has had an extensive experience in sinus work, he remarked that he had been impressed by the fact that the dura covering the anterior lobes did not seem to have the resistance to infection and to permit of the handling as does that in the temporal region. It has occurred to me that possibly the anatomical prolongations from the dura into the different foramina in this region, including those of the cribriform plate, have something to do, when under pressure, with increasing the susceptibility to infection and lowering the resistance.

No doubt the germ active in the individual case and the formation of the cell has much to do with the development of chronicity. Constitutional disease, syphilis, tuberculosis, etc., must ever be considered in our dealing with these cases and one very able assistant, the X-ray, should be used before any sinus operation is decided upon.

BRAIN ABSCESS COMPLICATING A LOCAL CRANIAL INFECTION

By WILLIAM SHARPE, M.D., New York City
Professor of Neurologic Surgery, New York Polyclinic Medical School and Hospital

IN discussing the condition of brain abscess, it must be remembered that a true brain abscess is a cortical and subcortical purulent formation, usually with but in the early stages without a definite limiting membrane or capsule; collections of subdural pus of a subdural abscess or of a localized purulent meningitis must not be confused with the condition of true brain abscess. The value of mortality and operative statistics of patients having the condition of so-called "brain abscess" has been greatly lessened owing to the greater frequency of subdural but extracerebral abscess formations and to their comparatively lessened danger to the patients, in that these subdural but supracortical abscess formations are usually well walled-off from the surrounding sterile subdural and subarachnoid spaces, so that they can be easily and safely drained directly through the dura; but to assert that a true brain abscess is present, merely because pus escapes upon puncturing or opening the dura of the mastoid area, frontal or sphenoidal sinus or infected fracture of the skull, is not warranted. It is only when the dura is adherent to the underlying cerebral cortex and the abscess cavity is within or beneath the cortex that the condition can be termed a brain abscess. It is this confusion of nomenclature which has rendered the statistics of the mortality of brain abscess of little or no value, since the mortality of true brain abscess is exceedingly high, whereas the mortality of localized subdural and meningeal abscess formations is less than 50 per cent.

The treatment of brain abscess is a surgical one, but its diagnosis and accurate localization are usually so difficult that any operation of drainage must be considered as an exploratory procedure; not only is this true of multiple metastatic abscesses in the brain as a complication of purulent foci elsewhere in the body, but also those abscesses of the underlying brain due to the extension of infection by contiguity of a fracture of the skull, gunshot injury, sinusitis and otitic disease. The great frequency of multiple abscess formations resulting from metastatic processes makes a most confusing clinical picture and the prognosis is always bad, whereas a solitary abscess of varying size is the complication of a local cranial infection. Fortunately in these latter patients, the subcortical abscess formation is frequently in close proximity to the primary infective process whether it be an overlying fracture of the vault of the skull, an underlying sinusitis of the frontal, ethmoidal or sphenoidal bones, or an ipsolateral otitic infection.

Unlike most brain tumors (excluding the gliomata) which produce an increase of the intracranial pressure by their added tissue formation or by a blockage of the ventricles, brain abscesses on the contrary replace brain tissue so that unless the escape of cerebrospinal fluids from the ventricles is blocked by a large subtentorial abscess formation, there are produced no signs of a marked increase of the intracranial pressure and this absence of high intracranial pressure is only of negative value in the diagnosis; a meningeal irritation, however, resulting from

the proximity of the abscess formation to the cortex will frequently cause an increase of the intracranial pressure and this serious complication of a possible acute purulent meningitis must always be feared; frequent cytological examinations of the cerebrospinal fluid are most helpful.

In the surgical treatment of brain abscess complicating a fracture of the skull, sinusitis, or otitic disease, it is essential to eliminate the original infective focus, and then (and this is the most important point to decide in the treatment of brain abscess of whatever cranial origin), if we are absolutely certain that the abscess formation lies directly beneath the affected dura and that this area of the dura is adherent to the underlying cerebral cortex, the ideal method of operative drainage is naturally through the site of original infection whether it be a fracture of the skull, a sinusitis of frontal or ethmoidal bones, or an otitis media with mastoiditis; that is, first we do the local operation to remove the original infective process from the area of the fracture of the vault, the frontal or ethmoidal sinuses and, in otitic disease which is the usual primary infective focus, the "cleaning out" of the mastoid cells and then exposure of the dura. The question now is whether this exposed dura should be punctured by an exploratory needle through the infected area of the fracture of the vault, the sinus or the mastoid cells in the hope that the brain abscess lies in the cerebral cortex just beyond the dura. I use the phrase "in the hope that the brain abscess lies just beyond the dura" advisedly, because in a large percentage of patients it is impossible to state with certainty that a cerebral abscess is present, and if it is present, to give its accurate localization. It is for these two reasons that the diagnosis of brain abscess, with few exceptions, must be a tentative one, and the operation of drainage must in reality be an exploratory procedure owing to the great difficulty of accurate localization even when the abscess formation is present. (The extradural abscesses as well as the subdural but supracortical and therefore extracerebral abscess formation must not be confused with the true brain abscess —a cortical and usually, a subcortical formation.) I repeat, if it is definitely known that the brain abscess lies in the cerebral tissue directly beneath the infected dura in which case the dura is frequently adherent to the underlying cortex, then the ideal method of drainage would be directly through this adherent dura into the abscess cavity itself—a cerebrodural route well walled-off by the adhesions of an earlier localized meningitis; but to attempt exploratory punctures through the dura, the sterile subdural spaces and into the cerebral tissue itself, in the hope of locating an abscess of the adjacent areas of the brain, and through the "dirty" infected field of the mastoid, or the infected sinus or the infected fracture of the vault, I say this method of operative procedure is not only lacking in surgical principles but, if the brain abscess is not found, it most assuredly aids in the formation of multiple subcortical abscesses as a result of the exploratory punctures and the extension of the infective process to the meninges so that an acute meningitis and meningo-encephalitis results. For fear of being misunderstood, it is only in those cases of brain abscess formation which lie directly beneath the dura of the infected area, such as the mastoid, and where the dura and the underlying cortex are adherent and well walled-off by the adhesions of a former localized meningitis that this method of opening the dura or puncturing it through the infected field of the mastoid should be advocated; if at the local operation of mastoidectomy or at the removal of infected cells of the sinuses or of infected bone of the fracture of the vault, there are found definite evidences of a subdural abscess in the color of the dura or of a cortical or subcortical abscess in the bulging, non-pulsating dura adherent to the underlying cerebral cortex, or if that most rare "stalk" of the abscess should be located, then in these patients and in these patients alone is it a rational and safe procedure to open or puncture the dura through this infected extradural field in the knowledge that the brain abscess lies directly beneath the operative area and that the sterile subdural spaces are well walled-off from the site of operation and drainage.

In a large percentage of patients, however, the local operation does not disclose any definite signs of a subdural lesion and the dura is not adherent to the underlying cerebral cortex, and these are the patients in whom it is distinctly dangerous to open or to puncture the dura and to explore intracerebrally in the hope that the abscess can be thus located and successfully drained. If the abscess is found by the first puncture opening, then its drainage through the sterile subdural spaces by a small opening is associated with the great risk of a purulent meningitis and if the abscess formation is not present or at least not located, then the danger of multiple abscess formations and a diffuse meningitis and meningo-encephalitis resulting from the exploratory punctures themselves is more than a probability; also, to puncture the dura one inch

or more above the infected field of the mastoid but through the same incision as the mastoid opening—this is *not* through a "clean" sterile area and it usually becomes infected from the mastoid as would naturally be expected.

It is in these fairly frequent cases that it is impossible to state with accuracy at the time of the mastoidectomy that the brain abscess lies directly beneath and contiguous with the dura of the infected mastoid area, and if the presence of a subtentorial and cerebellar abscess has been excluded (and cerebellar abscesses are the more easily diagnosed than the supratentorial and especially the temporosphenoidal ones), the operation of exploration of the temporosphenoidal lobe and the adjacent areas of the brain should be made through the "clean" subtemporal route as in the operation of subtemporal decompression and drainage. Naturally, the vertical incision should be used. If the brain abscess is not found, then the exploration has been performed with little or no danger of a resulting meningitis and at least a decompression has been afforded the patient in that the abscess may localize itself later. If the abscess is found, then it can be freely drained through the wide subtemporal opening with less risk of a meningitis occurring owing to the decompressive effect of the operation itself. If the abscess is in that part of the temporosphenoidal lobe adjacent to the infected mastoid area, then additional drainage of the abscess cavity may be obtained through this area. It has been my experience in these patients that cerebral tissues as well as the meninges are definitely resistant to infection from the drainage pus of the abscess itself if the intracranial pressure and the local pressure of œdema both from the abscess and from the operation itself, are not high, so that this exploratory operation of drainage through the subtemporal area is not only an efficient means of drainage if the abscess is found, but the complications of meningitis and meningo-encephalitis are greatly lessened. Besides this method of approach makes possible a much more extensive exploration so that if the abscess is not situated in the adjacent temporosphenoidal lobe, it can be satisfactorily drained if found in the ipsolateral frontal, parietal, or even occipital lobe. In my series of brain abscess cases, there are several of them which undoubtedly would not have been found if the exploratory puncture needle had been used through the mastoid area alone. As an efficient means of drainage, the double glass tubes, one tube within the other, so that the outer tube always remains in place in the abscess cavity while the inner tube can be removed and used as a means of suction-drainage, has been proved of distinct value.

In abscess formations of the cerebellum complicating otitic disease, the diagnosis and localization are usually not so difficult as in supratentorial lesions, and if at the operation of mastoidectomy with the dura exposed there are definite signs of an underlying cerebellar abscess either in the cerebellopontine angle or in the contiguous cerebellar lobe, then the dural drainage-puncture should be made directly into the abscess formation. However, if it is not definitely known that the abscess is situated subtentorially, then I believe no dural puncture should be made through the infected mastoid area but rather through a "clean" incision through the adjacent occipital area, that is, a unilateral suboccipital exploration and if necessary a bilateral operation.

CONCLUSIONS

The mortality of patients having the condition of true brain abscess is high; without operation practically 100 per cent, and with operation 70 per cent and even higher. Subdural and localized abcesses are excluded. The diagnosis of the intracranial condition and then the accurate localization are most difficult, and for these reasons the operation of drainage must always be considered as an exploratory procedure.

The ideal operative approach is the direct one—through the infected mastoid area, dura, and into the adjacent abscess cavity—but only in the presence of an adherent dura to the underlying cerebral cortex thus walling-off the infective process. In those other selected patients in whom the accurate localization of the abscess is not possible and in the absence of an adherent dura to the cerebral cortex, an exploration of the cerebral hemisphere should be performed through the "clean" subtemporal area, and, if the abscess is found, satisfactory drainage can be obtained. If the abscess is not located, then the risk of a resulting meningitis is practically nil, and it may be possible later to localize the abscess and to drain it. This operation, however, should only be used in these selected patients and the operation of mastoidectomy with wide exposure of the dura should always precede it in order to remove the primary infective focus and at the same time to ascertain the presence or not of definite signs of an adjacent brain abscess. If these signs are not present, however, the dura of this infected area should not be punctured in the hope of locating the abscess for the risk of a resulting meningitis is very high—whether the abscess is found or not.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held November 21, 1919, Dr. A. H. Curtis, President, Presiding

INVERSION OF THE UTERUS

Dr. Carey Culbertson: I desire to report, for the purpose of placing it on record, a case of inversion of the uterus. The patient was a primipara, 20 years of age and at term. I have not the date of her last menstruation, but she came into labor at 1 a.m. on October 4, 1916, with spontaneous rupture of the membranes. Delivery was accomplished at 7:15 a.m., October 6, 1916, by low forceps extraction, chloroform anæsthesia. The placenta could not be expressed spontaneously. Her attending physician waited 1 hour. Hæmorrhage then began and he introduced a pack. Hæmorrhage continued, the pack was removed, and the placenta manually delivered, after which the uterus was repacked. The records show that there was some continuous oozing until 12 noon on the same day. A second degree laceration of the perineum was not repaired.

In the afternoon of October 6, 1916, I was called to see this patient in consultation. She was pale; anæmic; pulse, thin and quick, 120 to 160; temperature normal. A mass was felt above the symphysis which was thought to be or was recognized at that time to be the uterine fundus. It felt hard and was well contracted through the abdominal wall. The vagina was tightly packed with gauze which was not stained by any present hæmorrhage. When I saw the patient she was in bed with the foot of the bed elevated. Strychnine had been administered, continuous normal salt solution was being given per rectum by the drip method and 3 pints had been introduced by hypodermoclysis. We regarded the case at this time as one of postpartum hæmorrhage in which the bleeding had been checked, and we did not disturb the packing which had just been put in.

On October 9, I was again called to see this patient. She had continued to bleed, the tampon had been removed, and the uterus again packed. At this time the abdomen was flat, soft and relaxed with a concavity similar to a hernial opening palpable in the plane of the inlet. The patient was taken to the operating room and the gauze removed from the vagina. It was then discovered that the vagina was distended by a soft bulging mass which proved to be the inverted corpus uteri. The cervix could be felt as a tight ring high up laterally and posteriorly. An attempt was made to replace the uterus by taxis, but this was unsuccessful. The cervix was then grasped by two volsella and pulled down as far as possible, the inverted corpus being elevated behind the symphysis. The posterior cervical wall or lip was then split mesially up as far as the vaginal fornix. With the finger the vaginal wall was then dissected from the cervix and the cervix from the peritoneum. With this dissection carried out the free edges of the cervical incision were grasped and pulled down into the field of operation until the constricting ring appeared to be free. With the whole hand in the vagina, the fundus could not be replaced. The posterior incision was then extended until the cul-de-sac was opened after which the corpus was very rapidly replaced. The cervix was then brought down by volsella and the line of incision sutured from above downward. The cervix had not been lacerated. The posterior cul-de-sac was then closed and the edges of the perineal wound freshened and repaired. The patient was then given stimulants and salt solution. On October 11, I heard from the attending physician that the patient had died.

DISCUSSION

Dr. Paddock: I would like to ask why the doctor did not remove the packing when he was called to see the case the first time. Perhaps I did not understand; perhaps he did remove it and repacked, but if he did not, is he sure that the packing was carried well up into the fundus and did not simply occupy the lower uterine segment? Also was ergot used?

Dr. Culbertson (closing): In answer to Dr. Paddock, I will say that when I saw the patient the first time in the morning she was in bed, her pulse was not good—it was very rapid and thin. I was told that the packing had just been put into the uterus and the vagina was tightly packed. There was no evidence of blood showing through the vaginal pack. I did not think it wise to disturb the patient sufficiently to remove the packing; that is, to take her to the operating room and remove the packing. There was a mass felt above the symphysis which appeared to be the uterus. That was the reason I did not disturb her at that time. The evidence seemed to be that the patient was not bleeding at the time of my first visit. The case appeared to be one of postpartum hæmorrhage in which the hæmorrhage had been checked.

The question regarding the reposition of a uterus that is infected is always a proper one and that was taken into consideration. This uterus as it presented into the vagina was quite white and dry, but began oozing slightly as soon as replaced.

The cause of death was given as acute anæmia.

With regard to ergot, I have no notes here. As I recall, it was prescribed.

EPITHELIAL MASSES IN THE OVARY

Dr. Arthur H. Curtis: During the last two years I have been interested in a study of fallopian tubes. It often happens in the removal of tubes that one has to remove the ovary which is in close contact with the tube. In examination of more than one hundred specimens, I found in two cases, very small epithelial masses in the ovary, microscopic in size. These I think are unquestionably embryonal rests, which would later develop into dermoid cysts.

KIDNEY LESIONS IN GYNECOLOGICAL PRACTICE

Dr. W. C. Danforth discussed the subject of kidney lesions in gynecological practice. (See p. 284.)

DISCUSSION

Dr. T. J. Watkins: I desire to call attention to the importance of the use of a method of *palpating the kidneys bimanually*, using much the same technique as is used in bimanual palpation of the ovaries and tubes. The usual method of causing the kidney to slip between the fingers is useful but is not sufficiently delicate, except in an occasional case. The other method permits one to obtain an intelligent idea of the size and sensitiveness of the kidneys in at least 95 per cent of women.

I also desire to emphasize the importance of instituting medical treatment for infection of the bladder and kidneys before resorting to instrumental examination, which always traumatizes more or less and which may result in contamination. A considerable percentage of cases of infection of the bladder and of the pelvis of the kidney will be cured with medical treatment. Should this prove inefficient, then the use of cystoscopy, ureteral catheterization, and possibly kidney lavage may be indicated. Our experience has been that the use of the above system has been very gratifying in a considerable number of cases.

Dr. C. Henry Davis: I have a patient who is of interest in connection with Dr. Danforth's paper. This patient was referred to me in the third month of pregnancy. At that time she gave a history of pain in the region of the right kidney of two years' duration. She had been told that she probably had a kidney stone. Examination of the urine showed albumin, a heavy trace, and microscopic examination showed both red and white corpuscles. The catheterized specimen of urine revealed a few colonies of colon bacilli and staphylococci. It was decided that she should be carried through with expectant treatment. She was delivered 18 days ago and for the first 9 days made an uneventful recovery. On the ninth day her temperature went up to 103°. For the next 4 days her temperature varied from 102 to 104.2°, with very severe pain in the region of the left kidney. An X-ray picture taken during pregnancy, showed a shadow about the size of a quarter in the region of the left kidney. Other pictures were taken shortly after delivery and showed the shadow of a stone in the same position. A catheterized specimen taken on the fourth day after delivery was sterile. A catheterized specimen taken after the flare-up in temperature was loaded with colon bacilli. It would seem in this case that the traumatism of labor so injured the kidney that there has been a recurrence of the colon bacillus infection in the traumatized kidney. The temperature has again returned to normal and we hope that she may subsequently come to the more simple operation for stone. One peculiar point in this case is that in the later weeks of pregnancy the patient was much more comfortable than she had been at any time within the past 2 years. She was always much more comfortable at night than during the day.

Dr. Barrett: I wish to speak of a patient I have in the hospital now, in whom infection and disturbance of the ureter took place as a result of a pus tube. The patient, a colored woman, entered the hospital in March, with multiple pelvic abscesses. The pelvis was what internes call a "frozen pelvis." We did not think the patient could stand a radical operation at that time. We drained the tube evacuating an enormous amount of pus. The patient was in the hospital until June and at no time did we consider her in a condition for a radical operation. We allowed her to go home and told her to come back if the infection recurred. She came back later, with a slight fever and enormous masses in the pelvis. Because of her improved condition, we felt justified in doing a radical operation.

Upon looking down into the pelvis it seemed as though the structures had all run together, and it was very difficult to distinguish one from the other. We worked down from the left side and found a pus tube in close attachment to the ureter, and removed the tube with difficulty. Elevating the uterus I came upon an enormous mass on the left side, which I worked out, taking the broad ligament with it. I put a forceps on the broad ligament on each side and rolled the tumor out and found that the ureter had been severed. The ureter had been pressed upon and infected by the mass and was friable and had been pushed up so that it lay close to the uterine artery. At first I thought we would leave the ureter, allowing it to drain and later probably take out the kidney. However, upon pressing the ureter down, while it was entirely free from the bladder up to the pelvic brim, we found the little narrow end and did an end-to-end-anastomosis. I then gathered enough peritoneum from different sources to make a covering for the ureter and put a drain-

age tube down deep enough so that we could secure proper drainage from the ureter. It leaked profusely for a few days and then leaked less and less. The patient is recovering, the ureter is intact, and there is no leakage of urine and no enlargement of the kidney.

DR. CURTIS: Is there urine coming out of that ureter?

DR. BARRETT: With the drainage tube in she was passing about 18 ounces of urine from the bladder. As the urine ceased to come through the drainage tube she passed more and more urine from the bladder and she is now passing about twice the amount. We have not cystoscoped her.

DR. JOSEPH L. BAER: I want to cite briefly two cases indicative of the way in which we are often misled.

Four months ago a patient was referred to me, who ever since her first pregnancy (she has now two half-grown children) had a mass in the region of her left kidney. Her physician had made innumerable analyses, all of them showing albumin, pus cells and occasional red cells, but she had always avoided having a more accurate diagnosis. Finally he impressed on her the importance of a more definite investigation. During this entire period she had one outstanding symptom: constant backache. The backache was so severe as to make her a semi-invalid although she was naturally a very vigorous and active woman. She went up to Rochester and the Mayos did a laparotomy and diagnosed the case as one of congenital cystic kidney. They closed the wound without further intervention. Some months afterward she saw me and because her backache was so typically sacral in character and as she had a distinct retroversion with the uterus, a relaxed perineum, and relaxed supports of the uterus, I felt disposed to consider the backache unrelated to the left kidney mass and suggested to her physician that I thought with plastic work her backache could be relieved. Under a general anæsthesia I suspended the anteflexed uterus to the abdominal wall and then did a perineorrhaphy. She is entirely relieved of her backache. Clinically she is well. She still has the so-called congenital cystic kidney with albumin, pus, and blood.

The other case I encountered some 5 weeks ago in a woman, aged 62, who was brought in with the clinical picture of acute renal colic. She had blood in the urine; she had intense pain, radiating from the high right lumbar region down the groin into the labium; she had a slight temperature and moderate leucocytosis. Her abdominal symptoms became more definite and 36 hours after the onset of the attack she was operated upon for acute appendicitis. A suppurative appendix was found overlying the ureter. She was a diabetic with a blood pressure of 220 and 10 days after operation she suddenly became very much worse and again developed the right-sided pain. Before operation a bimanual examination revealed an entirely free pelvis with only the stump of the cervix left following a hysterectomy some twelve years previously. The second bimanual examination after the onset of the pain revealed a beginning Douglas abscess, which was opened a week later. Her pulse ranged from 140 to 160. She had temperature and repeated chills. The Douglas abscess was evacuated. It is now 3 weeks since the second operation and in spite of the 200 blood pressure and the diabetes she is better, notwithstanding the fact that she developed a fæcal fistula which persisted for some 6 or 8 days and then apparently closed, there being now only a superficial abdominal opening.

DR. CURTIS: One or two points brought out by Dr. Danforth seem to me to merit further consideration. The first question is whether all these cases of pyelitis of pregnancy are the result of pressure upon the ureter. We very often have residual urine in the bladder with a considerable amount of pus. I wonder if they are not the result of residual urine.

About the use of disinfectants in washing out the ureter, I believe it has been the experience of urologists that it makes little difference what solution is used and that sterile water does as well as anything. Again, I think there has been a tendency recently to believe that irrigation of the kidney pelvis is not as helpful a measure as we formerly thought. In a recent conversation with Dr. L. E. Schmidt he told me he had given up pelvic lavage years ago.

DR. PADDOCK: The pressure of the pregnant uterus on the ureter causes infection. I have found in several cases of pyelitis in pregnancy that the knee-chest position several times a day was very beneficial and often curative.

DR. DANFORTH (closing): In the question brought up by Dr. Watkins as to the value of palliative treatment, I perhaps gave the impression of being more radical than I really am. I think in the acute stage when the patient comes into the hospital with high fever, she should be put to bed and treated. Many come in with pyuria without any temperature. In these we can immediately proceed to discover whence the pyuria arises. Dr. Davis spoke of a case where the temperature went up after delivery. I think it is very common to have a rise of temperature sometime during the first week. On the third, fourth or fifth day the temperature will shoot up and then come down, and this happens so frequently that you look upon it as a typical curve of a flare-up of a pyelitis. We do nothing for that except give urotropin. If the pyuria does not disappear after the patient is well and up and about, then we attempt to find out the cause.

I had an experience similar to Dr. Barrett's. I had a patient with a mass on the left side which was enucleated with difficulty. I also enucleated a part of the ureter and did an end-to-end anastomosis and the patient recovered, but had a leakage which did not disappear and finally necessitated removal of the kidney which finally we did and the woman is now alive and well. She had been under Dr. Babcock's care for a rapid heart. I saw another

case in which a surgeon took out a stone from the left ureter and a urinary fistula followed, which lasted for some time but healed up. This woman has a pyuria with colon bacilli. In a recent case in which I thought I did cut the ureter, I did a cystoscopy and found the ureteral opening discharging as usual. From the urologists I think we can get almost any opinion you like about irrigating the kidney depending on whom you ask. I recently had a talk with Dr. Kretschmer and he was as positive as one could be that any case of pyelitis or infection of the kidney which did not promptly heal should have lavage. He used a much stronger solution than I am in the habit of using.

The knee-chest position has been used for a long time and I have had many women go through without trouble. I think it is exceptional to have a woman abort.

As to the question of pressure upon the ureter, in spite of discussions in the literature to the contrary, I really think that pressure does exist, as evidenced by a case I reported. She was a doctor's wife, who had a marked pyelitis with pregnancy. In the attempt to carry her through her pregnancy we put a catheter in the right ureter up to the pelvic brim, but it would go no farther. After turning the woman on her left side the catheter passed up easily. This, I think, is definite proof that pressure existed upon the ureter.

As to the question of hæmaturia, I had not thought about it. I think the most logical conclusion would be that it would bear a relation to infections of the urinary tract.

MATERNAL MORTALITY

Dr. C. H. Davis read a paper on "Maternal Mortality." (See p. 288.)

DISCUSSION

Dr. C. S. Bacon: The pessimism of the author is easily understood. There is a reason for it but I doubt whether it is quite justifiable. I used to feel the same way when I was young, some 20 years ago, when I made a study of conditions in Chicago in a paper presented to the society. But physicians were not properly educated years ago in the schools, and there are still many in general practice. I hardly know how they are to be reached except through the hospitalization of obstetrical cases, in which respect there is certainly a great improvement. There are a great many more hospitals in this city, for example, and there is an enormous increase in the number of obstetrical cases going to the hospital in the last 20 or 30 years. With the improvement in the standardization of the hospitals which is now going on, which is under the stimulus of the work of the medical associations, especially the American College of Surgeons, and under the stimulus of the rules governing obstetrical technique, obstetrical practice is found to improve greatly. If we can help to increase the number of cases confined in hospitals, we will be doing good. I have no doubt that there will be an increase in the future. The great difficulty is, of course, with the poor and those in rather moderate circumstances—the cost and the difficulty of getting mothers away from their families. Anything that can be done to increase the number of beds devoted to obstetrics in hospitals for moderate cost is very important.

Dr. Paddock: I am convinced that these statistics are misleading. It seems to me looking back over the past 20 years that there has been improvement. The young men who have gone out into practice have certainly improved in asepsis, treatment, and skill and care in handling these cases. I cannot believe that the mortality is as great in the hands of the young men who are graduating today as it was 20 years ago. As the essayist has said, he saw only three cases and now they see 10 or 12 or 20. They handle some of these cases. I am not convinced that this mortality is entirely with the physician, but more with the midwives who have not improved in their treatment of cases. I would like to know the mortality percentage in the hands of midwives and in the hands of doctors. Also, I would like to know if these statistics are made up from abortions, that is, mortality resulting from abortion.

Dr. C. H. Davis (closing): I am very sorry, Dr. Paddock, but the statistics are against you. If your statement is judged by statistical reports your teaching has been of no avail. Dr. Meigs answers you on page 17 of her report:

"During the 23 years ending in 1913 in this country no definite drop in the death rate caused by pregnancy and confinement can be demonstrated; nor can any decrease in the death rate from puerperal septicæmia be shown."

Relative to midwives, you will find in the report of Dr. Williams, which was made to the American Medical Association in 1911, and published in the *Journal*, January 6, 1912, Vol. 58, page 1, that he comes to the conclusion doctors are as much responsible for the continued high maternal mortality.

During the past 60 years the number of cases delivered by midwives has been constantly decreasing, but the general maternal mortality has not decreased. You may find tables in the *Transactions of the Edinburgh Obstetrical Society*, 1010 11, xxxvi, 26, which show that the maternal mortality has not decreased in the last 60 years. I reproduced these tables in my little book on *Painless Childbirth* published in 1916. There has been a great decrease in the number of deaths from puerperal sepsis in hospitals. In early days great waves of puerperal sepsis swept through the hospitals and once started practically every woman developed an infection. At that time in no maternity hospital was there a death rate of less than 10 per cent and from that up to 50 per cent. But during the past 30 years the maternal death rate in hospitals has been cut down, until at the present time only a fraction of one per

cent of the patients cared for, even including those brought in from the outside infected, die from puerperal sepsis. Yet, according to all available statistics, the number of women who are dying from childbirth and puerperal sepsis remains as high today as 60 years ago.

Any of you who have not read the bulletin on Maternal Mortality, published by the Children's Bureau of the Department of Labor, should get it.

The ratio of maternal deaths per 1,000 live births in 1910 was 6.5, that is 6.5 mothers died for every 1,000 live births in the registration area. In 1916 it was 6.6. The average mortality from puerperal sepsis for the years 1901–5 was 6.3 maternal deaths per 100,000 population. In 1913 it was 6.0 and in 1916, 6.7 per 100,000 men, women and children. Now, gentlemen, these figures are available. We are all inclined to believe that because we in our practice rarely have puerperal sepsis, because we do not lose many cases from this cause in our hospitals, that deaths from puerperal sepsis are decreasing. Statistics indicate they are not decreasing; they have long remained stationary. It is time that we who are interested in diseases of women make a concerted and continued effort toward bettering this condition.

INFECTION OF PELVIC ORGANS AFTER RADIOTHERAPY

Dr. Curtis: The uterus that was removed this morning had been treated a few days ago with 50 milligrams of radium for 24 hours. I opened the uterus this afternoon. There was a cancer of the cervix which had not extended to the fundus. The radium had so affected the endometrium of the fundus that it was changed into a gray-green foul smelling sclerotic mess. This illustrates that infection of the pelvic organs is not unlikely after radiotherapy.

Dr. Harold O. Jones read a paper on the "Use of Radium in Pelvic Work."

CHICAGO SURGICAL SOCIETY

Regular Meeting, November 28, 1919, Dr. Charles L. Kahlke, President, Presiding

Dr. Emil G. Beck read a paper entitled, "A Further Report on the Treatment of Deep-Seated Recurrent Carcinoma by the Denudation Method."[1]

Dr. Samuel C. Plummer reported three elbow cases, exhibited plates, and showed lantern slides of the same.

Dr. Edward H. Ochsner read a paper entitled, "A New Skin Suture Material."

DEVICE FOR MAINTAINING APPOSITION IN FRACTURES

Dr. Joseph F. Smith, Wausau, Wisconsin: I wish to show a little device for maintaining apposition in fractures of bones in cases where there has been extensive crushing injury and exposure of the bones, with loss of bone substance.

My associate (Dr. Jones) was connected with Base Hospital No. 1 in New York, where they handled a large number of compound fractures, and they attempted to use a combination of the Lane plate with the Parham-Martin band, but were not successful because of the tendency of the plate to slip laterally. This device consists of a plate made of vanadium steel, having some sharp pointed spurs which we think will aid in eliminating the difficulty of lateral displacement.

I will simply pass the plates around for inspection.

We use a Parham-Martin band through the slots in the steel. The spurs can be driven into the bone to prevent lateral slipping. When the Parham-Martin bands are tightened the plate is held firmly in place and the spurs serve to prevent the lateral slipping.

These plates are designed to be used only during the period of antiseptic treatment of the wound and may be easily removed as soon as the wound is clear and callus sufficient to hold the bones in apposition has been laid down.

INTRACRANIAL PRESSURE

Dr. Cassius C. Rogers read a paper on intracranial pressure. (See p. 291.)

DISCUSSION

Dr. Karl Meyer: I agree with what the essayist has said in regard to intracranial pressure. A number of these cases have presented themselves at the Cook County Hospital from time to time.

About four months ago a man, 70 years of age, sustained an injury to the frontal lobe, causing a marked depressed skull fracture. He was sent to the Columbus Hospital where an attempt was made to trephine him and raise the depressed bone at least two inches in the frontal lobe. He was subsequently admitted to the Psychopathic Hospital with symptoms of paranoia. He was sent to the surgical service of the Cook County Hospital, and the depression raised. Shortly after operation he was dismissed from the County Hospital without any symptoms of paranoia and has remained well for six months.

Dr. Edward H. Ochsner: There are in the State of Illinois literally hundreds, yes thousands, of young people who are suffering from some defect which makes it difficult, if not impossible, for a large percentage to adhere to the ordinary standards required by society. If what Dr. Rogers has told

[1] Surg. Gynec. & Obst., 1919, xxix, 32.

us this evening is applicable in a large percentage of these mental defectives, it is one of the most remarkable things that has ever been discovered.

There are unquestionably many people who lie and steal because that is the way their ancestors made their living; they are simply schooled in that respect. There are many young people from good families whose ancestors have come through a lying and stealing period of many generations, who have short periods in their lives when they lie and steal and cannot help it. These young people are the most unfortunate and the most difficult ones in our society because they come in contact with the courts. They are sentenced to our juvenile institutions, which unfortunately are often schools for crime. Their experience makes them antisocial. They become anarchists; they are down on government; they are down on society. They are mighty bright and clever people, and they think that they are sent out into the world to "do" those who have done them. You cannot blame them very much. After one has been wronged two or three times, if he has any ginger in him, he is apt to hit back. These people have been injured by society; they have become so bitter they hit back.

The other class does not amount to much. They resort to petty thieving. They are not real, serious criminals. Most of you have had in your practice boys and girls who have done foolish things. Some of them come in contact with the law. If we could find a cause for producing such crimes and remove it, we would render an enormous service to society. I believe the solution of this problem is up to the medical profession. Criminologists have arrived nowhere. Crime is steadily on the increase throughout the world. The question of crime in Chicago and Illinois is a stupendous one, and if it can be solved, it would be the biggest problem that has been solved by the medical profession in the last twenty years.

Dr. Jacob Frank: I would like to say a word or two about traumatic intracranial pressure. Pressure may be due to an effusion extradural or intradural. It may involve the arachnoid or the brain tissue itself, or the lateral ventricle.

I have had occasion to open the skulls of a number of patients with slow pulse. A good deal depends upon where the fluid is situated. If it is extradural and you open the skull, you will get a free flow of fluid, and you will note immediately the effect of the slow pulse while the patient is on the table. You will observe the increase in pulse rate; the respiration will become better. If this does not take place, it is feasible to open the dura. I have seen cases where the fluid was between the dura and the arachnoid. If the patient does not react on the table, and the symptoms continue, it is advisable to tap the lateral ventricle. I have done that and have obtained fairly good results. I have punctured the spine without any beneficial results.

We know from the intracranial pressure experiments that have been made of injecting fluid into the lateral ventricle or subdural space, it will not pass into the spinal canal or vice versa. Many years ago, at St. Elizabeth's Hospital, when we had a great many cases of head injuries from railroad, horsecar, and cable car accidents, I demonstrated that point on the operating table. It is altogether different from intracranial pressure due to some pathologic condition. It does not do any harm to remove a part of the skull. If there is any hæmorrhage, it is quite a different matter. If we go back to the old classification of concussion of the brain, we know these patients will die, and if we read the old books on this subject we are told that no pathology in the brain is found. If you open the dura, you will see a small petechiæ. What good would it do to raise a part of the skull if pressure were in the ventricle? Those are the patients that die. Those patients in whom you simply raise the skull and see fluid escaping, and there is no internal pressure, get well. The extreme cases are those in which the pressure is in the brain itself and in the lateral ventricle.

Dr. Rogers (closing the discussion): I see a good many cases of fracture of the skull. I see cases that have been in the hospital as long as twenty-one days unconscious, with fracture of the skull, and nothing has been done except repeated tapping of the lumbar region. One man was tapped many times to relieve intracranial pressure, and died on the twenty-first day. I believe that man's life could have been saved by an early decompression, opening the skull and establishing extradural drainage.

With reference to the remarks made by Dr. Ochsner, I believe every one of these cases instead of being sent first to a reformatory should be sent to a pathologic laboratory for an examination, to see if anything can be done for them. I have never known of a man being reformed in a reform school.

CORRESPONDENCE

TEMPORARY STERILIZATION OF WOMEN

To the Editor: Under the above title in the December number of SURGERY, GYNECOLOGY AND OBSTETRICS, Dr. Turenne, of Uruguay, describes the technique of tubal sterilization as performed for the first time by him in October, 1916. In his article he questions the originality of this procedure, but says that so far as his knowledge goes, the operation has never been previously performed.

My first operation of this character was done on November 15, 1913, at the Polyclinic Hospital, the technique being identical with his, so far as I can judge from his description.

The history of my case is as follows: Mrs. L. J. W., age thirty-two, married eleven years, during which time she had given birth to three full-term children by instrumental deliveries, and had had two miscarriages at five weeks, cause unknown. She presented a lacerated and greatly relaxed vaginal outlet, with a well marked cystocele and rectocele. The cervix was lacerated, hypertrophied, and eroded. The uterus was small, anterior, and freely movable. At the operation the cervix was dilated and the uterus curetted. A bilateral trachelorrhaphy and perineorrhaphy was performed. The abdomen was then opened by a transverse suprapubic incision. The left ovary enlarged, cystic, and prolapsed, was resected. The right ovary and both tubes were normal.

The patient had requested sterilization and this was performed by embedding the fimbriated ends of each tube in a pocket on anterior face of broad ligament, holding in place by a continuous enclosing suture of fine silk. Convalescence uneventful.

Normal marital relations were resumed and continued until January, 1916, when she menstruated normally on January 17. The February and March periods were missed, and when I examined her on March 9, the uterus showed slight enlargement but no softening. There had been marked nausea and vomiting during the preceding month with beginning pains in the breasts. In the region of the left adnexa there was a globular tumor the size of an egg, that was markedly tender on palpation. She had been spotting every day during the previous month, a symptom which she had never had before. A diagnosis of ectopic pregnancy was made, and on March 11, the abdomen was opened through the scar of the old incision. A two-inch cyst of the left ovary was removed.

A transverse fundal incision was then made in the uterus, and what was, apparently an interrupted early pregnancy, with numerous old and new blood clots, removed. In this no fœtus was discovered, but the pathological report returned from the laboratory showed evidences of pregnancy.

The uterine incision was closed and the proximal ends of the tubes tied with linen thread sutures and cut, in order to make certain the sterilization attempted at the first operation three years before.

At this time I carefully examined the site of the embedding of both tubes. On the right side there was continuous union between the broad ligament and the circumference of the tube, and at no point could I discover any point of communication between the peritoneal cavity, and the embedded ostium of the tube. On the left side the embedding was equally perfect with the exception of one point anteriorly, where a minute opening, pin point in size, was seen. With a little force this opening admitted the passage of the smallest sized filiform bougie. Here was the means of communication between the abdominal cavity and the ostium of the tube, through which the ovum must have passed.

In using this technique for temporary sterilization, I was guided by the experience gained in attempting to relieve sterility where gonorrhœal infection had resulted in the so-called "clubbed tubes." In opening up these tubes at operation, I had repeatedly found that the fimbriæ could then be released, apparently as normal as ever. Some cases so treated have borne living children.

It therefore occurred to me, as it did to Dr. Turenne, that a good way to produce temporary sterilization, would be to close off the fimbriæ by embedding them between the folds of the broad ligament. I embedded them in my case on the anterior face of the broad ligament, so that, if by any chance the occlusion should not be complete, the opening would be at so great a distance from the ovary, that there would be little likelihood of an ovum entering.

But nature proved herself equal to the emergency. The ovum was carried to the anterior face of the broad ligament, presumably from the diseased ovary on the same side, and gained access to the embedded ostium of the tube through an opening so minute as to be almost imperceptible to the naked eye.

In view of further experience with these cases, I am inclined to think that a surer and better way of accomplishing temporary sterilization would be to invert the fimbriæ into the tube and close the lumen with a purse-string suture.

NEW YORK CITY CHARLES G. CHILD, JR.

AMERICAN COLLEGE OF SURGEONS

HOSPITAL STANDARDIZATION

HOSPITAL standardization under direction of the American College of Surgeons comes into its own. The minimum standard of the College, together with the progress now associated with it throughout the continent, makes up one of the great events in modern medicine. "The College," said Dr. Henry S. Pritchett, president of the Carnegie Foundation, in a recent interview in New York, "has advanced hospital conditions on this continent by ten years." In the following pages are given some excerpts from a recent report of the College (Bulletin Vol. IV, No. 4). This bulletin is of interest to every doctor.

The College has won by its disinterestedness. All of its work has gone for the better care of patients in hospitals. No specialty of medicine has benefited under its hospital program more than any other specialty. The breadth of view of the College and its idealism without sentimentality or "uplift" have won the support of doctors and of hospital workers. The work goes forward today with cumulative force.

With regard to the minimum standard, we quote from the bulletin: "It grew out of straight thinking of the clearest minds in medical and hospital work on this continent. It is practicable, workable, and constructive. It costs efforts rather than money. It safeguards the care of every patient admitted to the hospital by insistence upon competence on the part of the doctor, by thorough study and diagnosis in writing for each case, and by a checking up, at least once each month, of the clinical service of the hospital. It fixes responsibility throughout the hospital. It calls for the 'production sheets' of the hospital. It encourages and even compels research. It defines the minimum service to the patient which, beyond all debate, is considered essential."

The American College of Surgeons, at its beginning in 1913, included among its purposes the betterment of medical education and of the clinical practice of medicine. It recognized that matters of public health, the prevention of disease, and the intelligent distribution of the benefits of medicine are inseparable from these purposes. Work in these fields is known as hospital standardization. The following pages are a report of progress for the year 1919.

The administrators of the College took up hospital standardization with no preconceived idea or theory as to what should be done. They decided to study actual conditions, to find out what the normal processes of growth are and how these processes could be given speed. No "announcements" were made of this plan. But for two years a preliminary analysis was quietly pursued.

During these two years the College accumulated data from hospital folk and doctors; also the judgments of these groups as to what work could most wisely be undertaken, all of which served as a basis of procedure. These "assets" were gathered from every state in the Union and from every province in Canada. They grew out of conferences with hospital staffs, with city, county, and state medical societies, with superintendents, and with hospital trustees. In other words, the program of the College was built upon the cumulative wisdom of those concerned with it. As the climax to this preliminary work, the State Committees on Standards met in Chicago on October 19 and 20, 1917; and out of this conference grew the General Hospital Committee which met in Washington, December 8 and 9, 1917. Some details of these two meetings are given on page 11, Bulletin Vol. IV, No. 4.

After these two meetings the program of the College took more concrete form. That

program was, first, to define a minimum standard; second, to enlist the co-operation of the hospitals in the fulfillment of the standard, this work to be accomplished through personal visits to the hospitals by staff members of the College; and third, to publish from time to time the list of hospitals throughout the two countries which fulfilled the minimum standard. The publication of the list, however, was not to occur until the hospitals themselves generally approved of such publication, each hospital having been given full opportunity to meet the standard under normal conditions. The College anticipates at this time the publication in October, 1920, of a list of the general hospitals of 100 or more beds which fulfill the standard. A similar list of the smaller hospitals is to follow later.

The minimum standard, in accordance with this plan, was then defined. But this standard, as just explained, has been in process of coming gradually to light. It grew out of straight thinking of the clearest minds in medical and hospital work on this continent. It is practicable, workable, and constructive. It costs effort rather than money. It safeguards the care of every patient admitted to the hospital by insistence upon competence on the part of the doctor, by thorough study and diagnoses in writing for each case, and by a checking up, at least once each month, of the clinical service of the hospital. It fixes responsibility throughout the hospital. It calls for the "production sheets" of the hospital. It encourages and even compels research. It defines the minimum service to the patient which, beyond all debate, is considered essential.

Above all, the minimum standard is designed to bring a sense of responsibility to those who have to do with a hospital, that each patient admitted receives care scientifically sound. It is on this basis that the hospital may seek the confidence, good will, and support of its community; and it is through progress in this line that the medical profession may most swiftly advance to its rightful position in society.

The minimum standard as it has been adopted follows:

THE MINIMUM STANDARD

1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is "open" or "closed"; nor need it affect the various existing types of staff organization. The word *staff* is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the "regular staff," the "visiting staff", and the "associate staff."

2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields, and (b) worthy in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, and policies specifically provide: (a) That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.) (b) That the staff review and analyze at regular intervals the clinical experience of the staff in the various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analyses.

4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in an emergency, which includes the personal history; the physical examination with clinical, pathological, and X-ray findings when indicated; the working diagnosis, the treatment, medical and surgical; medical progress; condition on discharge, with final diagnosis; and, in case of death, autopsy findings when available.

5. That clinical laboratory facilities be available for the study, diagnosis, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluoroscopic service in charge of trained technicians.

AS MEASURED BY THE MINIMUM STANDARD

During the years 1918 and 1919 visitors from the College, in accordance with the foregoing program, visited the general hospitals of 100 or more beds in the United States and Canada. This list includes 671 institutions, the names and locations of which are given in Bulletin Vol. 4, No. 4.

The following table indicates in condensed form the findings of the survey in the hospitals of 100 or more beds. In this table 671 hospitals are considered. Of this group 198 hospitals meet today the minimum standard. Many of these hospitals have been visited twice during the last two years, and in such cases the second report was utilized in the table. In many instances, also, the hospitals pledged themselves to fulfill the minimum standard at the earliest practicable date and later made a signed report of the extent of their success. The reports of the hospitals received in this way are also embodied in the table.

STAFF MEETINGS, CASE RECORDS, AND CLINICAL LABORATORIES IN GENERAL HOSPITALS OF 100 OR MORE BEDS

1. IN UNITED STATES

Groups by Number of Beds	Hospitals in Each Group	Staff Meeting Each Month	CASE RECORDS							Clinical Laboratories		Hospitals Meeting Min. Stand.[1]
			Personal History	Phys. Exam.	Working Diag.	Lab. Findings	Treatment or Operation	Progress Note	Final Diag.	Path.	X-Ray	
100–149	282	91	131	117	112	181	178	112	194	170	174	66
150–199	133	49	67	56	54	95	93	56	97	90	95	37
200–249	65	27	30	31	27	40	40	27	40	40	40	22
250–299	57	33	32	31	28	42	41	28	44	44	42	24
300–349	24	13	13	12	12	18	18	14	20	21	20	8
350–399	11	6	6	6	5	6	6	5	6	6	6	3
400 or more	45	34	30	39	35	41	41	37	41	41	41	30
Totals	617	253	318	292	273	423	417	279	442	418	418	198

2. IN DOMINION OF CANADA

100–149	26	8	4	7	4	6	6	5	7	8	8	2
150–199	7	1	2	2	1	2	2	0	2	3	3	0
200–249	6	1	2	2	2	2	3	2	5	3	3	1
250–299	3	1	2	2	1	3	3	1	3	3	3	1
300–349	2	1	0	1	0	1	1	0	1	1	1	0
350–399	5	1	2	2	1	2	2	1	2	2	2	1
400 or more	5	3	3	3	3	4	4	3	4	4	4	3
Totals	54	11	15	19	12	20	21	12	24	24	24	8

[1] Number of hospitals in this column is reduced by failure in some instances to take action against division of fees.

PRACTICAL APPLICATION OF THE MINIMUM STANDARD

The practical application of the minimum standard to the hospital and the meaning of this standard, when in effective operation, to the community, are here considered.

The primary purpose of nearly all hospitals is the care of the sick or injured. This means that, as a matter of policy, the hospital seeks to render to each patient admitted the most efficient care known to the staff of the hospital. Hospitals and doctors accept this interpretation; otherwise the hospital would be merely a boarding-house for the sick or injured. Further, the trustees of the hospital, having accepted this policy, are responsible for the administration of the policy; and the people of the community have a right not only to assurance that the policy is carried out but

also to the facts upon which such assurance is based. It is only upon such a relationship of mutual confidence that the hospital may reasonably ask the good will and support of the community. Again, upon such a relationship rests the ultimate success of the hospital. The minimum standard is designed to foster just this fundamental relationship.

If the board of trustees is responsible that every patient, free or pay, in the hospital receives the best care known to the staff, then the board must at frequent intervals be in possession of the facts as to the care received by the patients in the hospital. The board must know, for example, if any unnecessary surgical operations are performed in the hospital; or if incompetent surgical operations are performed; or if lax, lazy, or incomplete diagnoses are made. If infections occur, the board must know, as nearly as may be, the cause of the infection, and it must know that every reasonable effort is made to remedy the cause. If the time of patients is wasted between their admission to the hospital and the proper study, diagnosis, and treatment of their illness, again the board must know the facts and take action promptly to prevent further waste of this kind. Too frequently hospital trustees consider that their duties end with the management of the financial affairs of the hospital.

Now let us suppose that in a given city the leading hospital has "put on a campaign" to raise $100,000, and that the chamber of commerce, desiring to help the hospital, sends its representative to the trustees to ask whether or not the service at the hospital is what it should be. In other words, the chamber of commerce wants facts; it wants the "production sheets" of the cure and relief of illness.

What can the trustees answer? If the hospital is one which meets the minimum standard, the trustees are in position to say: "We have the facts as to the clinical successes and failures in the hospital. We give you these facts and rest our claim for support on them."

But if the hospital is one which does not meet the minimum standard, the trustees will probably reply: "We hope that all of our patients receive the right sort of care. We believe that they do. But we really know very little about the matter." This answer is sentimental rather than businesslike and will seldom win today the confidence of an intelligent community.

In case of the latter reply the chamber of commerce, and in fact the entire community, will do well to withhold support until the hospital produces evidence that it is worth while. Among the 671 general hospitals of 100 or more beds in the United States and Canada, about 468 of them cannot present at this time even a fairly complete analysis of their clinical work.

Let us suppose now that the trustees of one of these 468 hospitals decide that they will seek in a businesslike way the confidence of their community. What is their procedure?

Can the trustees "inspect" the hospital and through this means make a report concerning the clinical work in the hospital? The answer is no.

What the trustees can do is to call the doctors together who practice in the hospital and put the matter squarely up to them. After a statement of their own responsibility in the matter, the trustees can say: "We want you to organize as a group or staff and to create among yourselves a group-consciousness (Minimum Standard, 1). You are the experts. We ask that you draw up rules and regulations which if wisely administered will, in your judgment, provide for each patient in the hospital the highest service which is in your power to give (Minimum Standard, 3). We ask, further, that you meet as a staff at least once each month and that at these meetings you analyze your work in the hospital; that you find your mistakes or failures and, in so far as you can, prevent recurrence of the same mistakes or failures (Minimum Standard, 3, *a* and *b*). We ask your co-operation, your guidance, and your confidence; we ask for the facts from time to time with regard to the clinical service in the hospital. In turn, we pledge our support."

The College in its work among hospitals has not found a single group of doctors practicing in a hospital who would not respond gladly to

such a request from the governing board of the hospital. Here and there certain "obstacles" to the plan are raised. The chief of these is that the doctors are too busy to hold regular meetings and analyze their work. But in answer let us ask: Is any doctor too busy to give his patients the best service in his power?

After the staff has organized and after it has agreed upon rules and regulations governing the professional work in the hospital, and after these have been approved by the trustees, then it becomes the obligation of the trustees, through the superintendent of the hospital, to administer or to carry out the rules and regulations. It is essential that a spirit of co-operation exist between the superintendent and the staff in the administration.

ANALYSIS OF CLINICAL RECORDS

In order to make more clear what is meant by an analysis of the clinical service of a hospital, let us consider the following two series of 100 operations for chronic appendicitis, both of which are fairly typical of what happens today in hospitals.

	In hospital No. 1	In hospital No. 2
Complete physical examination, including blood count	100	14
Number of consultations held	41	2
Working diagnosis recorded in advance of operation	100	None
Progress notes recorded by doctor	100	None
Incorrect diagnosis	1	14
Infections following operation	3	12
Number patients relieved	94	77
Number patients died	3	9

The analysis of the cases treated in hospital No. 1 shows that a complete physical examination was made and recorded for each patient; that in order to clear away doubt as to the diagnosis, consultations were held in 41 cases; that the working diagnosis in each case were, then, in fairness to the patients, recorded in the permanent records of the hospital; that, after the operations, the physicians or surgeons in charge of each case made or signed daily a statement of the progress of the patient; that infections developed in 3 cases; that 4 incorrect diagnoses were made; that the number of patients apparently relieved of their illness was 94; and that 2 of the patients died following operation. This record is a credit to the staff of the hospital.

The corresponding data are now given for a similar series of cases in hospital No. 2. The data as here presented could not occur in a hospital which meets the minimum standard. In a hospital which meets the minimum standard, for example, it is not possible that any patient, except in an emergency, will go to operation in advance of a complete physical examination. But in hospital No. 2 86 of the patients were operated upon without a complete physical examination. They were operated upon, it seems, after guess-diagnoses rather than after scientific diagnoses with consultations when indicated.

Considering the record of hospital No. 2, is there anything unreasonable in asking that the staff meet at least once each month, that it analyze the facts of its clinical work, that it determine, as nearly as may be, the causes of its failures; and that, demanding the support of the trustees, it endeavor to remove these causes? For example, 12 of the cases developed infection. Whose cases were these? What is the nature of the infection as indicated by laboratory analysis? Were the cases operated upon in rooms where pus cases had also recently been operated upon? Is the sterilization in connection with the operating room effective? When was it last tested and how? What technique is carried out in connection with surgical operations? And again, what were the reasons for the incorrect diagnoses? Do they indicate a lack of study, undue haste, or a failure to make full use of the laboratory facilities?

If the staff of hospital No. 2 would in dead earnest ask such questions as these each month, the percentage of infections would undoubtedly decrease. If the staff-review were really penetrating, the percentage of deaths would undoubtedly decrease. Matters, too, of incompetence, when the facts indicated incompetence, would be dealt with in no uncertain manner. The staff would become restricted (Minimum Standard, 2). The doctor scarcely exists who, if incom-

petent and if his incompetence is brought to light at frequent intervals, will not either endeavor promptly to perfect his training or retire from membership on the staff. The same principle is true with regard to character and professional ethics. Can any staff rest content with less than its maximum effort at all times to perfect the service of its hospital?

But the division of surgery, or the surgical cases, should not alone be analyzed by the staff. The clinical records of non-surgical cases merit quite as much attention. The study, diagnosis, treatment, and final result in pneumonia cases, cases of malnutrition, etc., should be reviewed. The services of the obstetrical department and of the children's department should, in the same way, be included.

In making analyses of clinical work, the confidential character of no record should be violated. The data for consideration of the staff may be taken from summary cards from which the names of patients are omitted. See Bulletin, Vol. IV, No. 1.

Various hospital staffs at this time are in process of finding out for themselves the most effective means of analyzing their clinical records. The data as indicated on page 20, Bulletin, Vol. IV, No. 4, are found by a number of hospitals to be of stimulating value when presented to the staffs. Copies of these data are placed in the hands of each member of the staff; point by point the data are reviewed and the responsibility for the character of the data is shared by each staff member.

In order to compile the data called for on the sheet, it is suggested that a daily review be made of the records of patients discharged. This review will include information under each of the headings of the sheet. When a daily record is kept in this fashion the summary for the month is merely a matter of arithmetic.

From time to time exhibits are made showing these data comparatively through a series of months. In addition to these data some definite report of the laboratory service of the hospital is helpful. This report should show the extent to which the laboratory is used; and in this connection questions as to the adequacy and competence of the laboratory service should be raised by the staff. The staff should especially recognize good work on the part of the pathologist. All gross material removed at operations should go to the pathologist for report; and the case record of each death in the hospital together with the autopsy record when available should be presented as a routine at the next succeeding staff meeting.

Explanation of the practical application of the minimum standard which grew out of the experience of the Staff at St. Vincent's Hospital, Los Angeles, and at The Woman's Hospital, New York, are given in this pamphlet. In this connection the staff rules and regulations as given in the appendix (Bulletin Vol. IV, No. 4) may also be helpful.

THE DIVISION OF FEES

In connection, further, with restricting the privilege of practice in hospitals, emphasis is placed upon the division of fees, or fee-splitting (Minimum Standard, 2). Fee-splitting is the buying and selling of patients. The practice exists in various forms, but the most usual form is as follows: A general practitioner makes a diagnosis in which surgical interference is indicated. He then refers the patient to a surgeon for operation. The surgeon operates, collects a fee, and sends to the physician one-third or one-half of the fee, this last transaction being unknown to the patient. Sometimes the physician collects the fee "for the surgeon" and retains his percentage as agreed with the surgeon.

Sometimes the fee is divided with the explanation to the patient that the physician "assists the surgeons" or gives the anæsthetic. In many such instances the explanation is a subterfuge for fee-splitting. A competent surgeon usually has a regular assistant and an anæsthetist with whom he is accustomed to work and is more able in this way to do good work than if he permits each referring doctor to assist him.

Undoubtedly the physician should be paid for the study and diagnosis of a surgical case. But he should be paid directly for this service by the patient. In the same way the surgeon should be paid directly by the patient. The

surgeon can frequently be of service to the physician and to the patient by explaining to the patient the value of the study and diagnosis made by the physician. But the accounts of the physician and of the surgeon should not be confused or rendered to the patient as a single statement.

The evils of fee-splitting are, first, that it makes for incompetent surgery. The surgeon who is party to the practice gets his cases usually not upon the basis of merit, but upon the basis of the percentage of fees collected that he will give to the practitioners. The more incompetent he is, as a rule, the larger percentage of the fees he gives to his co-fee-splitters.

Second, fee-splitting makes for unnecessary surgical operations. Under the fee-splitting system surgery becomes a commercial enterprise and not a professional service. Both the physician and the surgeon tend to make surgical diagnoses without adequate study, and the result is unnecessary surgery. Much of the unnecessary surgery of our present day is due directly to fee-splitting.

Third, fee-splitting, by introducing dishonesty into medical practice, lowers the entire medical profession in the estimate of the public. The fee-splitter, for example, says to his patient that he refers him to a most competent surgeon, when he knows well enough that if he, the physician, were to be operated upon, he would select another surgeon. Further, the fee-splitter usually poses before his patient as having received little or no fee for his services when, as a matter of fact, he has received a large fee indirectly from the patient. He holds such a fee really as a theft.

Fee-splitting is now prohibited by law in the following states: Minnesota, Wisconsin, Nebraska, West Virginia, Alabama, Ohio, Kansas, Iowa, Tennessee, Colorado, Michigan, and Georgia.

The great majority of physicians and surgeons are most sincerely eager to put an end to all fee-splitting. They ask the hospital trustees to help them in this matter by excluding fee-splitters from the privileges of practice in hospitals.

The College asks each hospital to make clear to its staff and to its community a definite policy against fee-splitting. Where no action has been placed on record in this matter, the College suggests that the governing boards of hospitals pass the following resolutions:

> *Be it resolved*, That the practice of the division of fees is inconsistent with the policy of ..... Hospital and that physicians and surgeons who divide fees are not permitted to practice in the Hospital; and further,
>
> *Be it resolved*, That a copy of these resolutions be sent to each physician and surgeon now practicing in the Hospital.

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LOCALIZATION OR ELIMINATION OF CEREBRAL TUMORS BY VENTRICULOGRAPHY

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IT seems incredible that a brain tumor as large as one's fist can exist in either cerebral hemisphere and still escape localization by expert neurologists and neurologic surgeons. Yet nearly all cerebral tumors eventually attain this size, and a very high percentage of them can neither be accurately localized before operation nor be found by an exploration of the brain.

In a recent analysis of a series of 70 cases with neoplasms of the brain, Dr. Heuer and I[1] have shown that of 45 cases which were presumably located in the cerebral hemispheres, 20, or 44.4 per cent, escaped detection at operation; and at the time of that publication we considered this a high record in verifying the location of cerebral tumors. This percentage is not strictly correct, for several of the cases were submitted to more than one operation before the tumor was disclosed. On the other hand, in many cases which seemed to present definite signs of localization, the tumor could not be found because it was situated too deeply in the brain.

A more careful analysis of these figures disclosed to an even greater extent the limitations of the neurological signs which are helpful in localizing brain tumors. Nearly all of the tumors which could be localized with certainty were in one of three locations,[2] in each of which the signs are pathognomonic: (1) hypophyseal or third-ventricle tumors gave the characteristic disturbances of the optic tracts and destruction of the sella turcica; (2) precentral or postcentral lesions were evident by the contralateral motor or sensory disturbances; and (3) neoplasms affecting the motor or sensory speech centers produced the typical deficiencies of speech. The remaining cases which were localized exclusively by other methods, such as changes in the eye-grounds, disturbances of the other cranial nerves, etc., really comprised a very small group.

There is only one satisfactory form of treatment for brain tumors, i.e., complete operative extirpation of the tumor. It is not conceivable that neoplasms of the brain ever disappear spontaneously or are cured or even benefited by any form of medical therapy. Nor, in our experience, has radium or the X-ray produced even temporary beneficial results. All attempts at medical treatment only cause delay which is disastrous to the individual; just as in the growth of malignant neoplasms of the breast, there is a time in the development of the tumor when its removal is possible and relatively easy and a complete cure will result. This opportunity

[1] HEUER, G. J., and DANDY, W. E.: A report of seventy cases of brain tumor. Johns Hopkins Hosp. Bull., 1919, xxvi, 224.

[2] These statements, of course, have reference only to lesions of the cerebral hemisphere and do not include tumors of the brain stem or the cerebellum. This paper is intended to consider only the localization of tumors which are supposed to be situated in the cerebral hemispheres.

is now too frequently lost in tumors of the brain because the diagnosis is made too late and because time is lost in misdirected and useless therapy. The treatment of intracranial tumors is now passing through the incipient and least fruitful stages, and is roughly where the treatment of breast tumors was 25 years ago, or where the treatment of appendicitis was 30 years ago. In both of these conditions the treatment has gradually become exclusively surgical and every effort has been directed toward an early diagnosis. The results of these efforts are now so thoroughly recognized that for all delay in treatment the physician in charge is held responsible.

When intracranial tumors are recognized and localized early, extirpation will be relatively simple and the permanent results will be vastly greater than those of today. The character and position of many tumors will, of course, preclude the perfect results which obtain in the operative treatment of appendicitis today, but they will undoubtedly surpass the operative results in early malignant lesions of the breast. Gliomata arising very deeply in the brain or in vital parts of the brain must still be looked upon as hopeless, but the vast silent areas harbor most of the incipient brain tumors, and from these regions tumors can be removed with impunity. There are even important areas which, with proper caution and due respect, are no longer considered *noli me tangere*, and from which tumors can be extirpated without permanent disability. At the present time, the operative procedures are greatly in advance of the methods of diagnosis, and in competent hands are fairly adequate. Small *enucleable* brain tumors can be removed with very little danger, and even large enucleable tumors can be removed with but a slight mortality, though the hæmorrhages in these cases require an operator of large experience. Small *infiltrating* tumors can be removed with the contiguous brain tissues with but little danger, but there is little chance of removing a large infiltrating tumor without a recurrence. Other things being equal the results, immediate and remote, are directly proportional to the stage of growth of the tumor.

Only as a last resort should an exploratory craniotomy or a decompression be done. A subtemporal decompression, though the simplest major cranial operative procedure, is often not only a useless operation to the patient but is frequently accompanied by a pronounced injurious effect. As a routine procedure it is questionable whether it does more good than harm. In all cases of hydrocephalus no relief can possibly result, for the cause of the hydrocephalus nearly always being in the brain stem, is unaffected and the ventricular dilatation continues to increase as rapidly as the extra space afforded by the bony defect will permit. This of course causes greater brain destruction. In advanced cases the result is not infrequently fatal, particularly so when the larger procedure of a combined exploration and decompression is performed. To perform a decompression or an exploration, an internal hydrocephalus should always be excluded. If a hydrocephalus is present a cerebellar exploration is usually, though not invariably, indicated. But here again the question of diagnosis is all important. It is frequently just as difficult to tell whether a lesion is in the cerebral or cerebellar hemispheres as it is to define its exact location.

At best a decompression is only palliative treatment and by the delay between the time at which a decompression is made for a so-called unlocalizable tumor and the later operation for its removal, after self-localization, the patient's chances of a complete cure have dwindled tremendously. The crux of the whole matter is that no brain tumor can be cured without operative removal; and that the earlier the diagnosis and localization is made the better the chances of a cure. The future outlook in the treatment of brain tumors is dependent almost entirely upon early recognition and localization of the tumor.

In a recent publication by the author, a new method—ventriculography or pneumoventriculography—was introduced, by which it was hoped that intracranial localization would be greatly assisted. At that time the procedure had been tried in only a few cases, but the results were such as to indicate

alluring probabilities. I now hope to show the efficiency of this method in *cerebral* lesions and where all other means at our command have failed to localize the growth. I venture the prediction that by an intelligent use of this method[1] in the hands of competent neurological surgeons but few cerebral tumors will escape localization. During the past two years I have completely removed over twenty brain tumors in Professor Halsted's service. Many more have been partially removed or treated by palliative procedures. Many of the tumors treated partially, and therefore unsatisfactorily, could have been completely removed had they been received earlier. The time will come when it will be just as reprehensible for a physician to delay the proper treatment in a case of brain tumor as it is now to await developments in a case of acute appendicitis. When one considers the terrible train of events which must inevitably follow the development of a brain tumor—blindness, headache, paralysis, aphasia, etc.—the burden of the delay must fall heavily upon those who are responsible for the failure correctly to diagnose the lesion or at least for the neglect in sending the patient to a competent neurologist or neurological surgeon.

PROCEDURE FOR LOCALIZATION OF THE TUMOR BY VENTRICULOGRAPHY

Each lateral ventricle occupies a large area in the interior of either cerebral hemisphere. It is evident that a tumor of any size situated in either cerebral hemisphere will modify the shape, size, and position of the corresponding lateral ventricle. Quite frequently the lateral ventricle in the opposite hemisphere will be dislocated and its size also will be greatly modified. These changes in the ventricles, both homolateral and contralateral, yield many opportunities for locating brain tumors by ventriculography. Fortunately following the injection of air into one lateral ventricle, it is possible to obtain a roentgenogram of each lateral ventricle separately, and thus determine alterations produced by a tumor in either cerebral hemisphere. Owing to the angles of the ventricular system, it is possible to fill only one lateral ventricle with air when the head is in a given position. After a roentgenogram has been taken, the head must be carefully turned in such a manner that the air can pass the various ventricular angles and the interventricular foramina (of Monro) and the third ventricle, and thus reach the opposite lateral ventricle. After a lateral view of each ventricle has been photographed, the head should again be carefully turned in order to direct the air into the anterior horns of both lateral ventricles; the occiput will then be on the plate and the roentgenogram will give the size, shape, and position of the anterior part of both lateral ventricles. Then by placing the forehead on the plate, the size and position of the body, and of the posterior and descending horns, can be demonstrated. It would seem that most tumors must give some manifestations of their presence in one of these views, and the findings must therefore absolutely indicate the position of the tumor.

To introduce air into the ventricles of an adult, it is of course necessary to make an opening in the skull. This can be done either under local or general anæsthesia, the choice largely depending upon the patient. Personally, I prefer local anæsthesia with a responsive patient. The procedure need be but slightly painful and after transferring the patient to the X-ray room his co-operation eliminates respiratory movements and allows a much better exposure; moreover a considerable period of anæsthesia is avoided during the time necessary to dress the wound and transfer the patient to the X-ray room.

A ventriculogram will in many cases at once tell whether the tumor is cerebral or cerebellar. In the latter cases an internal hydrocephalus will be evident by the symmetrically enlarged lateral ventricles.

In some cases it will be found that the size of the ventricle has been so reduced that it is impossible to withdraw sufficient fluid to make the injection of air a safe procedure. It is then best to make a ventricular puncture on the opposite side and inject air into this ventricle, though occasionally both ventricles

[1] DANDY, W. E. Ventriculography following the injection of air into the celebral ventricles. Ann. Surg., 1918, lxviii, 5-11; fluoroscopy of the cerebral ventricles. Johns Hopkins Hosp. Bull., 1919, xxx, 29-33; roentgenography of the brain after injection of air into the spinal canal. Ann. Surg., 1919, October.

are too small. Not infrequently we can localize a tumor merely by the difference in size of the two lateral ventricles as determined by the ventricular puncture or often by the abnormal position at which either ventricle may be reached. In a general way a very small ventricle is presumptive though of course not absolute evidence of a cerebral as against a cerebellar tumor or a tumor of the brain stem; when there is a difference in the size of the two lateral ventricles the tumor is usually on the side of the smallest ventricle. Even a bilateral ventricular puncture, which is only occasionally necessary, is a small procedure compared to an exploratory craniotomy or even to a decompression, and the results obtained in localization of the growth not infrequently make the puncture far more valuable than an exploratory craniotomy. In infants and very young children, a puncture can be made through an open fontanelle or through sutures which have been separated by the abnormal pressure.

During the past six months I have used ventriculography in over seventy-five cases from Professor Halsted's clinic. The majority of these cases had hydrocephalus; in many cases ventricular dilatation was suspected and the injection of air made the diagnosis certain. In many others the injection was made in order to determine whether the disease was progressive or stationary, in other words, as a means to determine whether or not operative treatment should be instituted. These cases will not be considered here but will appear in a subsequent paper. I shall describe here only the instances of tumors in the cerebral hemispheres or for very strong reasons suspected of being located there, and only those in which the ventriculogram has been the *sole* means of diagnosis. In many cases the localization of the growth has been easily determined by signs and symptoms and in such instances there is at present no purpose in instituting ventriculography, though I feel that eventually this method may be important in differentiating the type of tumor and determining the kind of operative treatment which is necessary. This possibility is strongly suggested by two of the cases which will be described, but such a decisive stand in treatment, which in many cases might eliminate exploration of the tumor, will only be determined by an extensive experience in the interpretation of the X-ray findings in a large series of brain tumors.

Five cases are described here, each representing entirely different findings and showing the range of usefulness of this procedure when tumors of the cerebral hemisphere are suspected. Ventriculography will be seen to exclude a cerebral tumor when the lesion is situated elsewhere; precisely to locate the tumor when it exists in either cerebral hemisphere. In two of these cases there was no localizing sign by which the location of the tumors was even suspected. In both, the ventriculograms showed the precise location of the growth. In one case the tumor was entirely removed and the patient is now well; he had previously submitted to two exploratory craniotomies but the tumor could not be found. In the second case a decompression had been done; after localization of the tumor by a ventriculogram, a very large infiltrating glioma was found at operation but could not be removed The patient was spared further useless operations by the ventriculographic localization of the tumor. In a third case the signs were differently interpreted; a large localized bulging in the right temple seemed to indicate an underlying tumor. There was a complete sensory and motor paralysis of the trigeminal nerve which could have resulted from pressure on the gasserian ganglion; or the paralysis might have been due to involvement of the trigeminal root in the posterior cranial fossa. The ventriculogram conclusively determined the location. In a fourth case, an exploratory craniotomy in a case of focal epilepsy disclosed a greatly dilated ventricle—apparently hydrocephalus; subsequently the ventricles were injected with air and the ventricular dilatation was found to be unilateral—a very rare condition. A fifth case can hardly be included as a result following ventriculography for air could not be injected, but the attempt at the procedure was responsible for locating the tumor. The ventricle was found by a ventricular puncture to be markedly dislocated to the left, but it was so small that only a few drops of fluid could

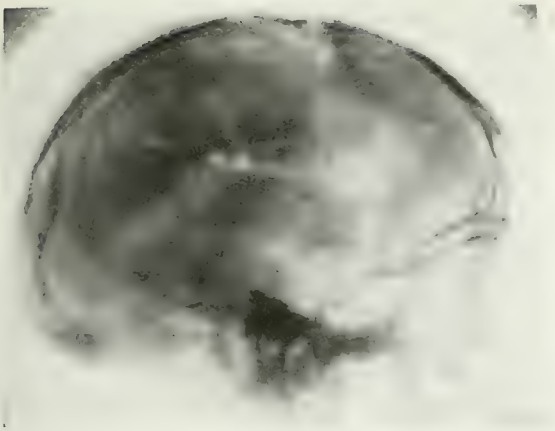

Fig. 1. Ventriculogram of a normal ventricle, lateral view.

be obtained from the needle. Under such conditions it is not safe to inject air. The dislocated position of the ventricle could only be caused by a tumor in the opposite side of the brain. The extremely small size of the ventricle must be due to the intracranial pressure produced by the tumor. The neoplasm was found in the right prefrontal region and completely removed.

LOCALIZATION OF A TUMOR IN THE OCCIPITAL LOBE, BY VENTRICULOGRAPHY

The difficulties and ofttimes the impossibilities of correctly localizing a brain tumor by the older methods and the simplicity of making the diagnosis by ventriculography will be seen in the observations which follow.

A sallow young man of 23, consulted me for disturbances caused by a tumor of the brain. The diagnosis of a cerebellar tumor had been made by one of America's foremost neurological surgeons and a cerebellar operation performed by him one year previously; the tumor was not found and consequently no relief was obtained. A year later he complained of constant headaches, with severe periodic exacerbations, and particularly of a progressive loss of vision. That the patient had a brain tumor was evident at a glance. A huge cerebellar hernia had followed the first operation and at once indicated a high degree of intracranial pressure. There was a bilateral choked disc measuring 6 diopters in each eye. But the position of the tumor was obscure. The only real objective finding was a complete deafness on the right side; bone conduction as well as air conduction was entirely absent. There was a suggestive Romberg; at times a slight fine

Fig. 2. Ventriculogram showing cross section of both lateral ventricles, also normal.

nystagmus, and a suggestive bilateral ataxia of the fingers. The patient insisted that the deafness followed the operation. He was sure of this because he had been in the telephone business and had used both ears equally well; moreover the deafness was noticed immediately after recovery from the cerebellar operation. The subjective symptoms were equally confusing and at that time could not be correlated into the results of a single intracranial lesion. His illness dated back 4 years, at which time severe attacks of bifrontal headaches and vomiting occurred periodically and steadily progressed in frequency and severity. Sixteen months ago diplopia appeared and after lasting for 2 weeks, disappeared and never returned. One month later the left half of the face became anæsthetic over night. He claims the left side of the face was paralyzed also. (He says he could not close the left eyelid and the left corner of his mouth drooped.) The sensory change was quite typically confined to the trigeminal area, ending sharply at the midline. The sensory (and motor) changes of the face lasted about two weeks. The left side of the face is still subjectively slightly numb, but there is no objective sensory or motor difference between the two sides. There was a sudden exacerbation of the headaches at the time of onset of these facial disturbances and vision then began steadily to diminish first in the left eye, later in the right. It is worthy of note that neither arm nor leg were affected at this time or subsequently. Two months after the onset of th se symptoms, the previously mentioned cerebellar operation was performed. Four months later the patient had a convulsion

Fig. 3. Photograph of a young man from whom an encapsulated tumor was completely removed from the left occipital lobe. It is now two years since the operation, he is perfectly well and again at work. Prior to the successful operation two exploratory cerebellar operations had been performed, one elsewhere, the second by myself. The tumor was finally located solely by ventriculography. The succeeding photographs graphically show the trials undergone by the patient pending a correct localization of the tumor. The following ventriculograms demonstrate the simplicity of localization by air injection.

and remained comatose for 4 days. No localizing signs were noticed by anyone during the convulsion. The patient insists that following this period of coma the large occipital hernia which resulted from the operation almost disappeared and later gradually resumed its natural fullness and hardness. There had been a slight disturbance of gait with a tendency to stagger; but it was inconstant and the patient thought it no more than his general weakness could easily explain. No staggering had been observed by his friends. The visual fields showed great restriction of vision in both eyes. There was only slight vision for color in the left eye and this seemed to show a nasal hemianopsia; this was not considered significant because it was the terminal phase of color vision and the field of vision in the right eye showed no such form. A slight grade of convolutional atrophy was present in the skull, indicating that an intracranial pressure existed.

The problem then was how much reliance to place upon the patient's subjective sensations, which seemed paradoxical. It was difficult to see how a complete deafness could result on the right side from the operation as he had claimed. It was impossible to put much confidence in his assertion that the left side of the face was paralyzed (facial nerve). He might easily have thought his face was paralyzed because of anæsthesia; or as happens most frequently the facial paralysis, if present, may have been on the opposite side. As is well known patients and even physicians often mistake the side of facial paralysis. If the *left* trigeminal nerve (V) had been paralyzed, obviously the *right* auditory nerve (VIII) could not be destroyed by the same lesion. The patient could not by any possibility mistake the side which had been anæsthetic (cranial nerve V). If the facial nerve paralysis had been present and had been on the left side it seemed conceivable that a lesion in the left cerebellopontile angle could explain the anæsthesia and facial paralysis, but it would be necessary to disregard entirely the right auditory paralysis (nerve VIII) which he claimed had followed the operation. On the other hand if the auditory paralysis (nerve VIII) had resulted from the tumor and not from the operation a cerebellopontile tumor could explain it and also a possible right facial palsy (VII) but not the anæsthesia of the left side of the face (V). In either case it seemed most probable that the tumor was located in either cerebellopontile angle or possibly in a lobe of the cerebellum. To support this was the transient nystagmus, suggestive Romberg and ataxia, and possibly a slight staggering gait. Transitory hemianæsthesia of the face and facial paralysis are not uncommon in angle tumors. The absence of sensory or motor weakness of the arm and leg seemed to indicate that any facial paralysis must be a peripheral involvement of the facial nerve (VII) rather than involvement of the facial area of the pyramidal tract.

As a result of these deductions I was led again to explore the cerebellar region. It seemed either that the tumor might have been overlooked by the previous operator or that a tumor lying deeply in the cerebellum might by this time have grown nearer the surface. All these presumptions and analyses proved false. A thorough exploration of the cerebellar region and both cerebellopontile recesses revealed no evidence of a tumor. The foramen of Magendie was normal. The large hernia was mainly due to an enormous collection of cerebrospinal fluid, which of course would inevitably reform. Though greatly disappointed at the negative outcome of two big operations, the patient still hoped for a

Fig. 4. Ventriculogram showing right lateral ventricle in patient shown in Fig. 3. The ventricle is probably slightly dilated.

Fig. 5. Ventriculogram of left lateral ventricle of same patient. It will be seen that the posterior and descending horns of this ventricle are absent and that the body of the ventricle ends posteriorly in a very sharp convex line. The tumor has occluded the ventricle and fills the space posterior to the ventricular shadow (see dotted line). The sharp line of demarcation indicates an encapsulated and therefore removable tumor. *a*, Posterior part of the body of the ventricle.

diagnosis which we saw little hope of attaining. A ray of hope appeared in ventriculography, but its value at that time had not been tried. The procedure was mentioned as a possibility to the patient; its uncertainties and possible dangers were emphasized. He eagerly grasped the opportunity.

Seventy-five cubic centimeters of cerebrospinal fluid were removed from the right ventricle and an equal amount of air substituted. Roentgenograms of both right and left lateral ventricles were taken, first in profile and then in an anteroposterior view. The shape of the right lateral ventricle is normal although it may be slightly enlarged (Fig. 4). (The normal variations in size of the lateral ventricles have not yet been accurately determined.) The size of the left lateral ventricle was the same as the right but it suddenly ended near the middle of the body of the ventricle (Fig. 5). The anterior horn and the anterior portion of the body of the left ventricle were almost exactly like the corresponding parts of the right ventricle, but no air reached the posterior end of the body, the posterior horn or the descending horn of the left ventricle. These portions of the ventricle therefore threw no shadows and were absent in the roentgenogram. The air shadow terminated at a sharp curved line, with concavity directed forward. These findings could admit of but one interpretation —the tumor had completely occluded the body of the ventricle and had prevented the air reaching the posterior and descending horn. The tumor must, therefore, be situated in the left occipital lobe. The anteroposterior ventriculogram (Fig. 6) shows the left ventricle pushed toward the right and partially occupying the right half of the cranial chamber. The right ventricle is also dislocated farther to the right than its normal position. The anteroposterior ventriculogram alone would have shown the tumor to be in the left cerebral hemisphere, but the lateral view of the left ventricle disclosed the exact location of the tumor.

As a subsequent operation a craniotomy was performed directly over the tumor in the left occipital lobe (Fig. 9). An area of tumor about 1 by 1 centimeter reached the surface of the brain. After circumvection of the blood vessels, the cortex over the tumor was divided and the tumor readily shelled out of its bed (Fig. 8). It was perfectly encapsulated except at one point; here the tumor arose from the ependyma in the upper outer wall of the descending horn, near its junction with

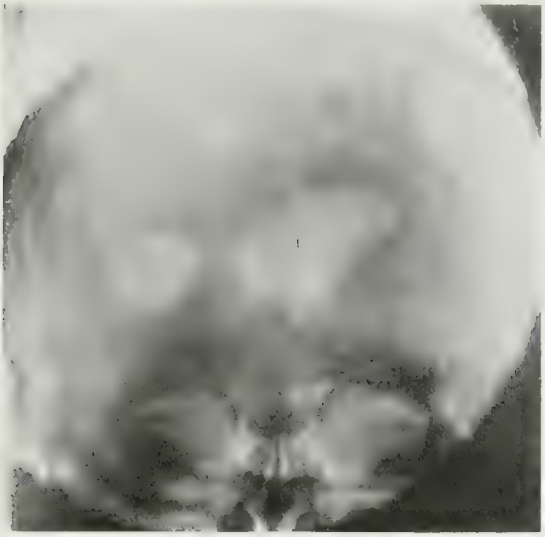

Fig. 6. Anteroposterior ventriculogram of same patient. Both ventricles are pushed far to the right side (the tumor is in the left occipital lobe). The left ventricle, *b*, is well over the mid-line and partially occupies the left side of the cranial chamber. *a*, Right ventricle.

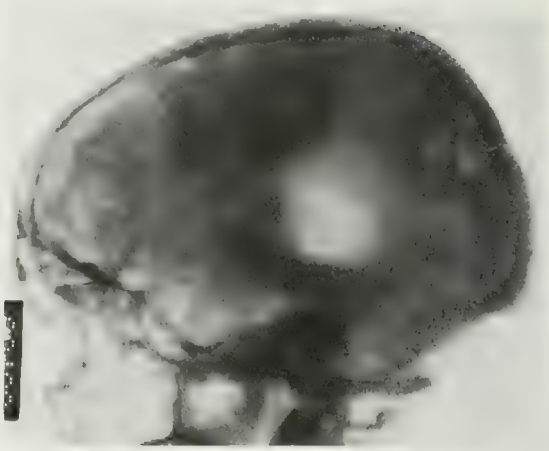

Fig. 7. The interior of the tumor contained a cyst which was accidentally punctured. The cyst was then filled with air. The roentgenogram shows the size and position of the cyst, and gives some idea of the position of the tumor. The solid part of the tumor extended to the surface of the brain, and the anterior and inferior limits extend somewhat beyond the cyst shadow. (See tumor outline in Figure 5.)

the posterior horn. It was, of course, necessary to open the ventricle widely and thoroughly resect the wall of the ventricle from which the tumor arose The glomus of the choroid plexus had attached itself to the tumor. It was stripped away and left intact. The ventricle was apparently completely occluded by the intruding growth. The descending horn of the ventricle was definitely enlarged (localized hydrocephalus); the body of the ventricle was well over to the right of the midline exactly as the anteroposterior ventriculogram had indicated. The entire tumor with the wall of the ventricle was removed. It is now two years since the operation and the patient is perfectly well and at work. There has also been a marked restoration of vision.

In the light of the operative findings, it is now evident that the patient's history was largely correct, but I am still uncertain about the facial paralysis. The auditory nerve paralysis (nerve VIII) undoubtedly resulted in some way from his first operation. The sudden but transient attack of severe headache, vomiting, left trigeminal anæsthesia (nerve V) was due to a sudden occlusion of the ventricle by the ingrowing tumor. A left facial paralysis (nerve VII) could not by any chance have occurred. A right facial paralysis is conceivable from pressure of the localized hydrocephalus, on the face center of the pyramidal tract, but this hardly seems probable. He probably mistook the anæsthesia for motor paralysis. The block in the ventricle had produced an acute hydrocephalus localized to the descending horn of the ventricle (because the ventricle is situated distal to the obstruction). This sudden localized hydrocephalus compressed the gasserian ganglion or the three branches of the ganglion, producing the left trigeminal anæsthesia. The tumor was situated too far posteriorly to have produced *direct* pressure on the gasserian ganglion. A channel in the ventricle subsequently opened and the sensory and possibly motor paralyses were relieved to a great extent. The enlargement of the descending horn is now understood, for there is only one outlet for the cerebrospinal fluid in the descending horn and that is into the body of the ventricle.

DIFFERENTIAL DIAGNOSIS BETWEEN A TUMOR IN THE TEMPORAL FOSSA AND THE CEREBELLOPONTILE ANGLE

The above localization of a cerebral tumor when a cerebellar neoplasm is suspected, has a counterpart in the following diagnosis of a

cerebellar tumor when a temporal lobe tumor is suspected. At least there are very valid reasons for the differences of opinion in the diagnosis.

A girl of 13 had suffered from headaches most of her life, but during the past 3 years they had become gradually more violent. There were numerous spells of projectile vomiting. Since childhood a large swelling in the right temple had caused a marked facial disfigurement. Diplopia had been present at times. Only recently signs of cerebellar involvement had appeared. There was a definite Romberg with tendency to fall to the right; staggering gait with tendency to waver toward the right; a slight but definite ataxia of the right hand; a slight diminution in hearing on the right; adiadochocinesia, and nystagmus. All these were outspoken objective evidences that the cerebellum was involved. There was a bilateral choked disc which measured six diopters in each eye. But the outstanding features of the case were the large boss in the right temporal region (Fig. 12) a complete sensory and motor paralysis of the fifth nerve and a right facial paralysis which was also nearly complete. The boss and the anæsthesia had been present for several years. The masseter and temporal muscles were completely atrophied on the right side there being no muscular response whatever; the anæsthesia over the entire trigeminal area was complete Taste was lost on the anterior two-thirds of the tongue. The right corneal reflex was absent. There was no hemianopsia, but a general restriction of the visual fields and of the visual acuity. Hearing was present but less acute on the right. There were two possible locations for the growth and plausible reasons for each diagnosis. During the previous three years she had been to two very prominent surgeons, each of whom had wished to remove the tumor mass from the temporal region. They thought the growth was a bony tumor which had originated there, and in its later growth had projected into the cerebellar fossa, producing the cerebellar signs of comparatively recent onset. There were three very good reasons for this diagnosis. First, the large local protuberance had all the appearance of a tumor; second, the complete paralysis of the trigeminal nerve and its long duration before the more recent involvement of the other cranial nerves particularly the facial nerve (VII), and the auditory nerve (VIII) which arise very close to the fifth nerve. The complete fifth nerve palsy (V) could easily be explained by direct pressure of the presumed tumor of the middle cranial fossa on the gasserian ganglion, especially since the trigeminal paralysis had been present for years and was complete. The X-ray showed increased density in the right parietal region; this was definite but not sufficiently pronounced to be a primary tumor of the bone; if a tumor at all it could only be an underlying soft tumor of the brain. On the other hand the assumption of tumor in the region of the gasserian ganglion or

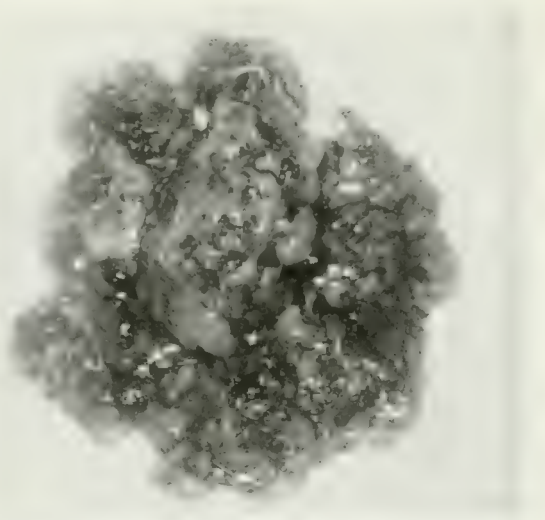

Fig. 8. Photograph of the tumor which was removed from the occipital lobe. See preceding figures. The tumor arose from the ependymal lining of the wall of the descending horn (upper part) of the ventricle. A view of the entire lateral ventricle was easily obtained during the operation.

elsewhere in the middle cranial fossa, rendered the explanation of the cerebellar signs difficult. Only an extension of the tumor through the tentorium cerebelli into the posterior cranial fossa could produce the cerebellar signs Such an extension of a tumor may indeed occur but it is quite exceptional. On the other hand if the origin of the tumor was in the region of the cerebellum, how could one explain the large unilateral boss in the temporal fossa? It could only be said that occasionally in hydrocephalus, there is a localized bulging in the temporal fossa, but I have never seen one so prominent. Such an explanation of course presupposed a hydrocephalus which was not known to exist and it further assumed that the hydrocephalus dated back to early childhood when the skull was very plastic. The head was possibly slightly larger than normal. The swelling had been present as long as the parents could remember, but they thought it was still growing although very slowly. Paralysis of the temporal and masseter muscles accentuated the prominence of the swelling but could not explain it as relative rather than actual.

The solution of the confusion in the diagnosis lay in the presence or absence of an internal hydrocephalus. If an internal hydrocephalus was not present the boss in the temporal region would probably be due to a tumor in that locality and the right lateral ventricle would probably show signs of dislocation or compression from the tumor. On the other hand if a hydrocephalus was

Fig. 9. Patient shortly after the tumor was removed. The large bulging in the suboccipital region followed the first cerebellar exploration which was done elsewhere. The size of this hernia has now greatly lessened but the separation of the muscles will prevent its total disappearance. The anterior curved incision was made directly over the tumor.

present it could not have resulted from a tumor in the temporal fossa but the tumor must have been situated in the posterior cranial fossa. Except in rare instances, only tumors in the brain stem or cerebellum can produce a symmetrical bilateral internal hydrocephalus.

The entire operative procedure for relief of such a case was dependent upon the ventriculogram. The ventricles were found by ventriculography to be greatly and equally dilated. Unfortunately the patient was in the terminal phase of pressure when she arrived and her condition did not warrant a cerebellar operation. A subtemporal decompression would have accomplished nothing beneficial but would no doubt have ended fatally. At necropsy the tumor was found in the cerebellar region as indicated by the internal hydrocephalus shown in the ventriculogram. It was an invasive glioma probably of congenital origin. No doubt the tumor had remained comparatively dormant for years and then resumed a sudden activity. The high grade of hydrocephalus and the corresponding reduction in the cerebral cortex are well demonstrated in the ventriculogram (Fig. 13).

In both this case and the one preceding the tumor could not be located by the usual methods. In the first case two operations were performed in the wrong location because of misleading signs and symptoms. In the second, two surgeons wished to operate on the temporal region and were prevented only by the patient's hesitancy to undergo the operations. I thought the tumor to be in the cerebellar region but the diagnosis could not be certain; others regarded the tumor as in the middle cranial fossa instead of in the posterior cranial fossa. Although a very high grade of hydrocephalus existed, only the ventriculogram could prove it. In both cases the ventriculogram alone was decisive.

LOCALIZATION OF AN INOPERABLE SUBCORTICAL CEREBRAL TUMOR

Another instance of a brain tumor clinically unlocalizable, but clarified by the ventriculogram was a man aged thirty-seven.

His symptoms were rather fulminating—headache and vomiting of only three months' duration. A bilateral choked disc of 4 diopters was the only possible objective finding. A subtemporal decompression had been performed by Dr. Heuer but the tumor grew so rapidly that the decompression had ceased to be of value in less than a month. A right ventricular puncture was then made under local anæsthesia. Because of the extreme intracranial tension which was indicated by a very tight decompression I was afraid of acute pressure symptoms and injected less than 30 cubic centimeters of air which was sufficient to fill only the descending horn of this ventricle (Fig. 10), but the size of the left ventricle (Fig. 11) was so reduced that the injected air was ample to fill it entirely. The ventriculogram therefore indicated a normal right ventricle and a left ventricle greatly and fairly uniformly reduced in size. The various horns of this ventricle were about equally affected. The anterior horn, however, was pushed backward and downward by the tumor. Later a left craniotomy was performed and the tumor was found to be a very extensive infiltrating glioma but coming to the surface in the frontal region. The surface compression of the convolutions suggested an extensive subcortical involvement

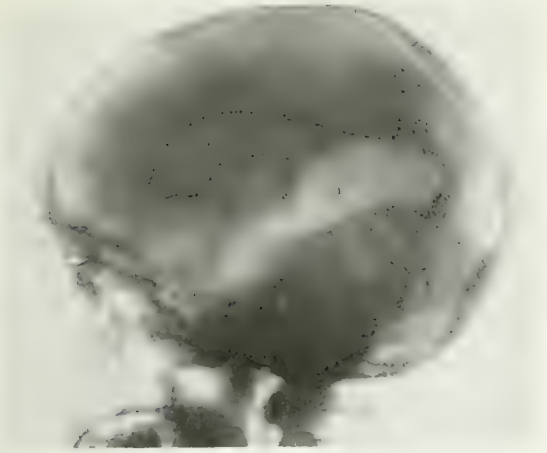

Fig. 10. Ventriculogram of right lateral ventricle of a patient with an unlocalizable tumor of the brain. Only the descending and posterior horns, *a*, of this ventricle are filled with air. The contour of the remainder has been projected in a dotted line, *a'*, to contrast with the opposite side. There is no occlusion in the ventricle because the air passed freely to the opposite side. (See Fig. 11.)

Fig. 11. Ventriculogram of left lateral ventricle (right shown in Fig. 10). The size of this ventricle is greatly reduced in all of its component parts, due to pressure of a large tumor. The anterior horn, *a*, is also pushed downward and backward. The contrast between the size of this ventricle and that on the right (Fig. 10) is striking. The same quantity of air which filled only the posterior and descending horns of the right ventricle filled the entire left ventricle and part of the third ventricle. (The foramen of Monro can be seen at the junction of the third and lateral ventricles, *b*.) The tumor was found at operation. It was an infiltrating glioma and too extensive to permit removal. The circular zone in the roentgenogram is the defect in the bone produced by a subtemporal decompression. *c*, Posterior horn of ventricle; *d*, descending horn of ventricle.

of the frontal and temporal lobes. The tumor was too large to attempt removal, but an extra large decompression was left further to alleviate his symptoms.

UNILATERAL HYDROCEPHALUS DEMONSTRATED BY VENTRICULOGRAPHY

During a recent craniotomy for Jacksonian epilepsy in a child of six years I was surprised to find what seemed to be a large cyst in the right post-Rolandic region.

On incision this cyst proved to be a huge lateral ventricle. The posterior horn and the descending horn had lost their normal configuration because of the tremendous distention. There had been no reason to suspect an internal hydrocephalus; the eye-grounds were normal; the roentgenogram of the head showed no signs of intracranial pressure. There was a distinct abnormality of the surface of the brain. Extensive obliteration of both the cerebral arteries and veins in the parietal and occipital lobe had left a pale white, soft cortex posterior to the Rolandic fissure. Numerous tiny new arteries passed through the meninges, apparently a recent and new development to replace those which had been destroyed.

For months prior to the operation and since the onset of the Jacksonian epilepsy, the patient had had a high irregular fever, a marked tachycardia and at times had been comatose. Apparently there has been an extensive vascular thrombosis at this time.

After convalescence from the operation, permission was obtained from the parents, to inject air into the ventricles for ventriculographic observations. The results of these studies are graphically shown in the accompanying ventriculograms. The hydrocephalus is unilateral, a most unusual condition. The left ventricle is of normal shape (Fig. 15,*a*), its size somewhat larger than normal though I have not had a sufficient number of normal ventricles to tell how large the normal variations may be. The right ventricle is a tremendous cyst (Fig. 14 and Fig. 15, *b*) but the enlargement is principally posteriorly, where the vascular affection was most pronounced. In the strict sense this cannot be a true hydrocephalus, for there is, at least now, no increased intracranial pressure. The unilateral dilated ventricle is undoubtedly due to softening of the cerebral walls from the vascular disturbance. The softened area atrophied from the pressure in the ventricles. In a true

Fig. 12. Photograph of patient who had cerebellar signs and symptoms but a large swelling in the right temporal region. This was regarded as the tumor by the surgeon who advised removal. The ventriculogram (Fig. 13) explains the swelling to be secondary to an internal hydrocephalus.

unilateral hydrocephalus the foramen of Monro must necessarily be occluded. At a subsequent operation I removed the choroid plexus from the dilated ventricle and occluded the foramen of Monro by a transplant of fascia as I have done on animals, following Professor Halsted's suggestion. There was immediate cessation in the attacks but this phase of the story will be considered in a subsequent paper.

The condition in this case could not have been known, even after the operation, without a ventriculogram. In fact a ventricular puncture and a roentgenogram would have given the same information without the exploratory craniotomy, and the first operation might have been spared the patient.

LOCATION OF A CEREBRAL TUMOR BY VENTRICULAR PUNCTURE WHEN THE VENTRICLE IS TOO SMALL TO PERMIT THE INJECTION OF AIR.

In some cases of brain tumor, possibly due to a very rapid growth of the tumor, the size of the ventricle on the side of the tumor and at times even of the contralateral ventricle

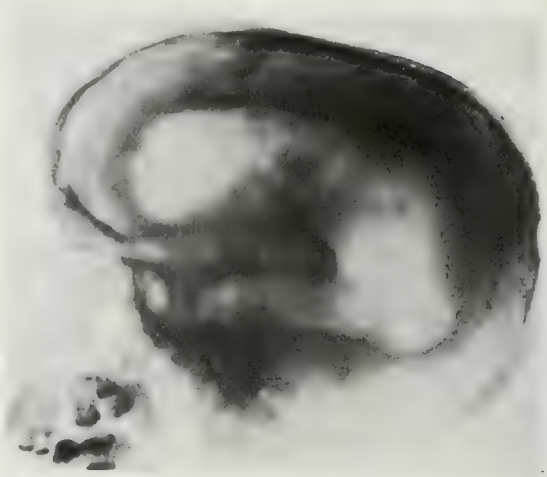

Fig. 13. Ventriculogram of lateral ventricle of the patient shown in Fig. 12. A high grade of internal hydrocephalus was conclusive evidence that the tumor was in the cerebellar region. The unilateral swelling in the temporal region was secondary to the hydrocephalus.

is so reduced that only a few drops of fluid can be obtained by a ventricular puncture. In these cases enough fluid cannot be aspirated safely to permit the injection of the air for the purpose of obtaining a ventriculogram. If air should be injected under such conditions, an acute rise of intracranial pressure might follow, possibly with disastrous results. But in these cases there is usually a definite dislocation of the ventricle; this is frequently great enough to cause difficulty in locating the ventricles by a puncture. But when the ventricle is found, its position may explain the the location of the tumor.

A young woman of 24 was suffering from a rapidly growing intracranial tumor. The signs and symptoms gave absolutely no clue to the location of the growth. Pursuant to our newer conception of the importance of an early localization of the growth, I made a right ventricular puncture and found the ventricle dislocated toward the left side, but only three or four drops of fluid escaped from the needle. Since air could not be injected under these circumstances without risk, a ventricular puncture was at once made on the left side but the left ventricle was no larger and despite the high grade of intracranial pressure (6 diopters swelling in each optic disc) only a few drops of fluid escaped

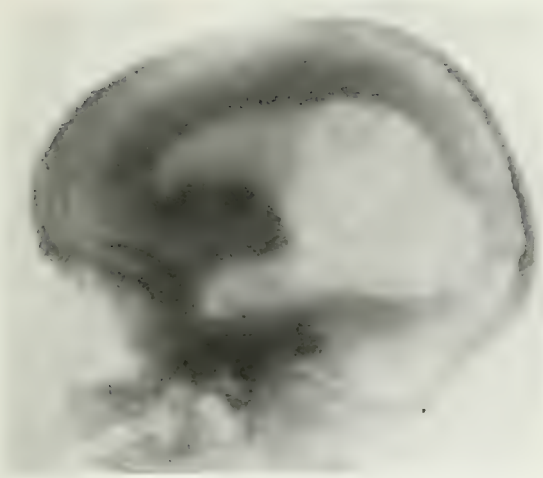

Fig. 14. Ventriculogram showing tremendous cyst-like dilatation of one lateral ventricle. The patient was operated upon for focal epilepsy.

Fig. 15. Ventriculogram of opposite lateral ventricle which is much smaller. Some air is still present in the large ventricle, the outlines of which are superimposed. The operative defect in the skull is also visible.

and no more could be aspirated. This ventricle also was dislocated markedly to the left. It was evident that the tumor must be in the right cerebral hemisphere and that it had pushed both lateral ventricles toward the left; however, the exact localization of the tumor on the right side could not be made in any way. In view of these findings a right exploratory craniotomy was performed and a large extracortical circumscribed tumor completely removed from the right frontal lobe. The patient recently left the hospital perfectly well.

CONCLUSIONS

1. Ventriculography is invaluable in the localization of obscure brain tumors. So-called unlocalizable tumors comprise at present over half of the total number.

2. Practically all brain tumors either directly or indirectly affect some part of the ventricular system.

3. Hydrocephalus is easily demonstrable by ventriculography and when present usually though not always restricts the location of the tumor to the posterior cranial fossa—that is, the brain stem or the cerebellum.

4. Local changes in the size, shape, and position of one or both ventricles as shown by the ventriculogram will accurately localize most obscure tumors of either cerebral hemisphere.

5. Every effort should be made to localize the tumors before resorting to any operative procedure.

6. The usual subtemporal decompression is useless and dangerous when a hydrocephalus is present, that is when the tumor is in the brain stem or cerebellum.

7. A suboccipital decompression (cerebellar operation) is extremely dangerous when the lesion is in the cerebral hemispheres.

8. To differentiate between cerebral and cerebellar lesions is frequently one of the most difficult tasks in intracranial localization. Ventriculography at once separates these two groups and indicates the operation of choice.

9. The only cure for brain tumor is extirpation. The results in terms of complete cures of brain tumors will be in proportion to the early localizations which are made. A decompression is a purely palliative procedure and should be adopted only when the tumor cannot be located. Ventriculography permits of an early and accurate localization of the growth when all other methods fail.

10. It is possible to get a separate profile ventriculogram of the whole of each lateral ventricle. Any change in size or contour is easily demonstrated. Anteroposterior views will show the same points in cross section but they are chiefly useful in showing any lateral dislocation of the ventricles.

11. The results in localization of five types of cases of brain tumor are shown with ventriculograms. In all but one of these, the ventriculogram was the only means by which a positive localization could be made. One tumor occluded a lateral ventricle and dislocated both lateral ventricles. Another tumor altered the size and shape of one lateral ventricle. In a third case a cerebral tumor, though suspected, was eliminated by the hydrocephalus. In a fourth case a unilateral hydrocephalus was demonstrated.

12. Occasionally the size of both ventricles is so reduced that air cannot be safely injected. In one case the dislocated position of both ventricles, which were greatly reduced in size, made the localization possible.

13. Ventriculography is also useful in *precisely* localizing the growth. This permits of an exploration *directly over the tumor* and greatly simplifies the operative procedures.

14. Many useless and harmful operations will be spared the patient by a judicious use of ventriculography.

15. Doubtless the type of tumor will often be indicated by the ventriculogram. Such knowledge will be useful in prognosis and in determining whether radical or palliative operative treatment should be instituted. These determinations will result from accumulated experience in the interpretation of the ventriculograms together with the correlative operative findings presented in a large series of cases.

16. With experience and care in the use of ventriculography, I believe few tumors will escape accurate localization.

NOTE.— The accompanying ventriculograms were taken by Miss Mary Stuart Smith from Dr. Baetjer's department. The shadows have been very slightly accentuated by Mr. Broedel to overcome the loss of detail in reproduction. The original X-rays are just as sharp as the figures as they are here reproduced.

AN EXPERIMENTAL STUDY OF URETERAL LIGATION; DEMONSTRATION OF LATE RESULTS TO URETER AND KIDNEY[1]

By JOHN R. CAULK, A.M., M.D., and R. F. FISCHER, M.D., St. Louis

A PRELIMINARY report on ureteral ligation was given before this Association in 1915, the basis of the report being the discussion of a patient on whom both ureters had been ligated during a hysterectomy for fibroids, and who had passed no urine for eight days. It was recognized early that the ureters had been tied, but the surgeon awaited developments, thinking that possibly the catgut would loosen and the ureter would open spontaneously. At the end of the eighth day the patient became uræmic. At this time I saw her and advised double nephrostomy, which was acceded to and done with very little disturbance to the patient and with the result that during the next twelve hours over 100 ounces of urine were secreted, the analysis of which showed a specific gravity of 1007, a trace of albumin and the sediment to contain granular and hyaline casts and red blood cells. Drainage through the nephrostomy tubes was free until the fifty-eighth day, when the patient voided. Ten days later the urine was passed entirely by the bladder and the wound had healed.

At this time the patient's condition was good, but the kidney function as determined with phthalein was quite low. Since then I have watched this patient with great interest. She is in excellent health, and her renal function has returned to normal limits. This observation clearly demonstrates that kidneys which have been completely obstructed for 8 days are capable of promptly resuming their function after drainage. This has been experimentally shown in the recent works of Keith and Pulford, and of Johnson. Furthermore, it establishes conclusively the fact that ureters which have been ligated with absorbable material may eventually open and drain sufficiently to allow closure of the nephrostomy wound, with the resulting complete restoration of health to the individual and without evidences of late ureteral obstruction.

Besides this case we have seen a number of instances of this complication of pelvic surgery; one other double, and several single involvements. We believe that this complication occurs more frequently than is supposed. Barney has collected 62 cases of occlusion during pelvic operations. Of these, 46 were unilateral and 16 bilateral. Kelly and Burnam state that ligation is the most frequent complication of the ureter during pelvic surgery. In this paper we will confine ourselves strictly to ligations and wish it to be clearly understood that ureteral severance is

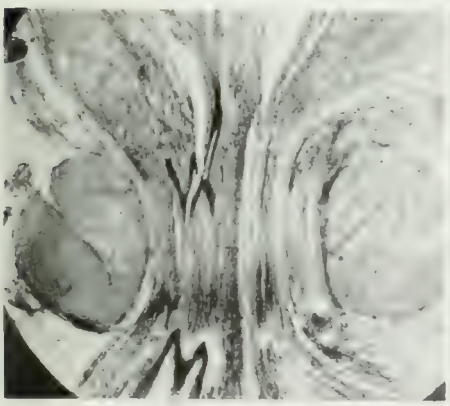

Fig. 1. Ureter at site of ligation. One hour

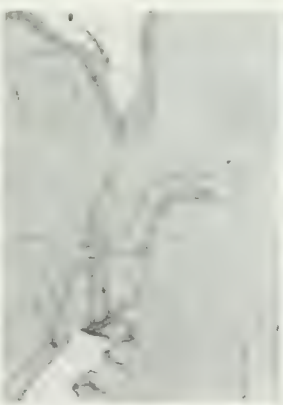

Fig. 2. Five weeks.

Fig. 3. Six weeks.

[1]Read before the American Association of Genito-Urinary Surgeons, June 16, 1916.

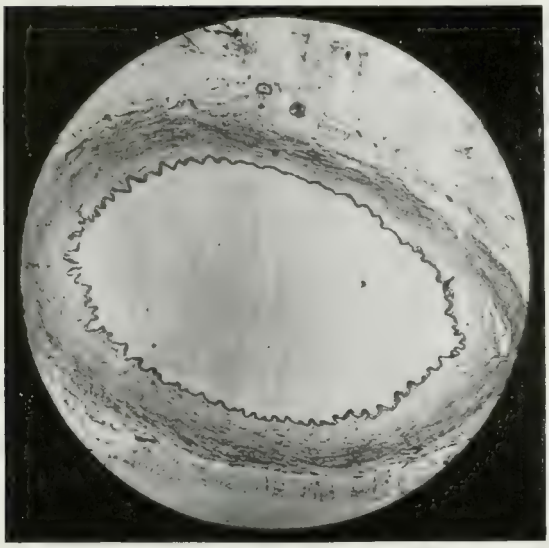

Fig. 4. Ureter above ligation.

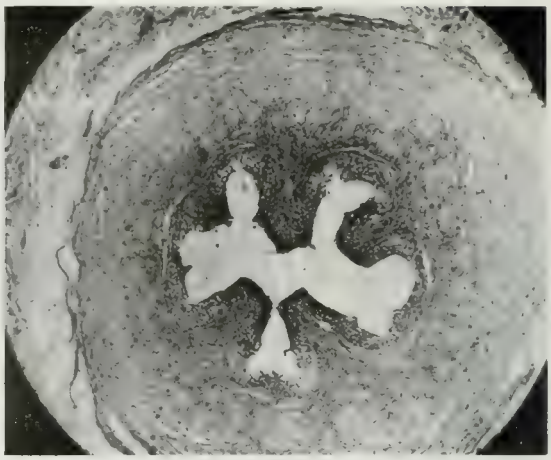

Fig. 5. Ureter below ligation.

not under consideration. The bilateral cases, of course, manifest themselves by anuria, and demand urgent relief, whereas a unilateral ligation, owing to either complete absence or a great paucity of symptoms may not attract the surgeon's attention to the possibility of renal occlusion.

The clinical cases which we have observed stimulated us to undertake an experimental investigation of this important point. Our preliminary report dealt only with the immediate effects of such ligations and bore chiefly on the subject of double ligation in which urgent measures are indicated in order to save the life of the individual. We wish now briefly to summarize our previous findings and to append our observation on the late results.

Experiments were done entirely on dogs, and in all 70 animals were used. The pathological specimens have been demonstrated to the American Urological Association at its meeting in St. Louis and to the Society of Clinical Surgeons. At present we will not give a detailed protocol of all the experiments, but for the sake of brevity will summarize our findings. The problem before us appeared to be as follows:

In case of double ligation, is it better to deligate the ureter, to do a ureterovesical anastomosis, or a double nephrostomy in the hope that the ureters will finally open and the kidneys be saved? Inasmuch as the idea seems current that catgut, the ligature usually employed, will be absorbed sufficiently within a few days to allow the ureter to open, we endeavored first to determine the time necessary for the absorption of No. 2 plain catgut (Fig. 1); second, if the ureter after such ligation would finally open, and the manner in which this opening occurred; third, the length of time required for it to open; and lastly, the renal complications at various intervals following sudden occlusion of the ureter.

Our experiments consistently showed that No. 2 plain catgut was never absorbed before the end of three weeks. In other words, it would be futile to wait for the catgut to be absorbed before attempting to save the kidney.

Granting that the catgut would not be absorbed before the death of the individual in the case of double, or before almost complete, destruction of the kidney in the case of single ligation, one of the three procedures just suggested, namely, deligation, ureterovesical anastomosis, or nephrostomy, must be adopted. The ideal method, of course, would be immediate deligation, but such an operation would seem to be attended with considerable difficulty, inasmuch as searching for a tie on a ureter deep in the

Fig. 6. Fig. 7. Fig. 8.

Fig. 6. Deligated right ureter at end of 1 year.
Fig. 7. Right kidney and ureter at end of 1 year. Nephrostomy fourth day; tie left on ureter. Notice open ureter.
Fig. 8. Kidney atrophied at end of 1 year. No nephrotomy; ureter open.

pelvic cavity several days after an extensive resection, is a problem attended with considerable difficulty. Even in animals we have had trouble in removing the ligature, owing to its being buried within the ureteral wall, and in a fair proportion of the experiments our attempts to deligate without cutting the ureter, in spite of our strictest attention, were unsuccessful. In several instances in which I have known of its being done clinically, the ureter has been incised with a resulting fistula, or a ureterovesical anastomosis performed at the time.

Such anastomoses at best are not entirely satisfactory and are frequently attended with contraction and obstruction, and certainly are difficult under the circumstances. Furthermore, the danger of hæmorrhage must be considered since the ligature which implicates the ureter also includes within it the uterine vessel.

Faced with these difficulties and occasional dangers, we undertook the problem above described and found, as some of you will remember, that the first indication of the formation of a lumen through the site of ligation occurred at the fifth week (Fig. 2). There was at this time a budding out of epithelium both from above and below, growing toward each other, and a definite column of epithelial cells joining them. We also noticed a beginning lumen which seemed to funnel from above. At the end of six weeks the canal had found its way through the connective tissue and had opened sufficiently to allow fluids to be injected through (Fig. 3). We will not describe in detail the preparation of specimens or the pathological change in the ureteral wall above and below the ligature, as they were given completely in the previous report.[1]

At the end of 8 weeks the ureteral lumen is fairly well opened and while the gross specimen

[1]Tr. Am. Ass. Genito-Urin. Surg., 1915.

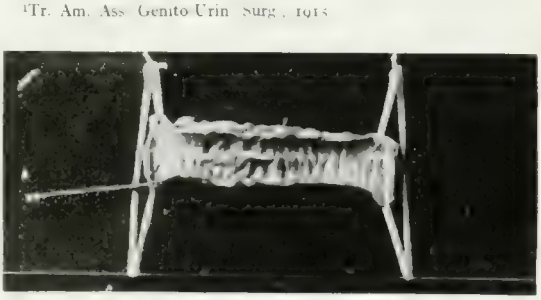

Fig. 9. Section of ureter at 7 months. Notice open lumen at site below.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 10. Right ureter ligated 1 week.
Fig. 11. Right ureter ligated 1 week, but kidney drained third day.
Fig. 12. Same as Fig. 11. Section.

seems to demonstrate that the site of ligation is considerably restricted, it is universally found that this is more apparent than real, as far as the lumen of the ureter is concerned, since the proportionate size between the lumen of the lower ureter and of the compressed ureter is not as much at variance as the ureteral wall would indicate. At 12 weeks the lumen is more open and there is much less pronounced constriction. The wall of the ureter in this segment is thinner and composed of delicate connective tissue, etc.

We have several animals which have gone a year following the ligation. Those which were nephrotomized and in which we were successful in keeping the drainage tube in the kidney in place for several weeks, have remained healthy and well; the kidney sinus has subsequently closed and at autopsy at the end of this time, the kidney on the side corresponding to the ligation has been remarkably well preserved, in striking contrast to the kidney which was not drained behind the obstruction. (In such a case there is, of course, complete atrophy. Figs. 6, 7, 8.) The lumen of the ureter is open and free (Fig. 9), and a No. 6 catheter passes easily, but the ureter itself is shorter and thicker than a normal one.

The ultimate opening of a ureter following a protracted ligation serves as a demonstration of the amount of damage a ureter will tolerate without the production of a pronounced stricture. It also confirms my strong belief that ureteral strictures are not as frequent as one is led to believe; that the majority of them are spasms in the neighborhood of inflammatory processes. This can be beautifully demonstrated, clinically, by the administration of repeated doses of atropine to patients who seem to have a ureteral stricture, whereas they can frequently be easily catheterized with a large catheter after atropine, notwithstanding their previous impermeability.

Effects upon the kidney. We shall not consume time in giving the detailed findings of the kidney complications secondary to complete ligation of the ureter as they were thoroughly described in the previous paper, and have been fully studied by Lindemann, Sollmann, Williams, Legueu, Cohnheim, Pierce, and beautifully illustrated by the splendid work of Barney, which was presented before this association; more recently by

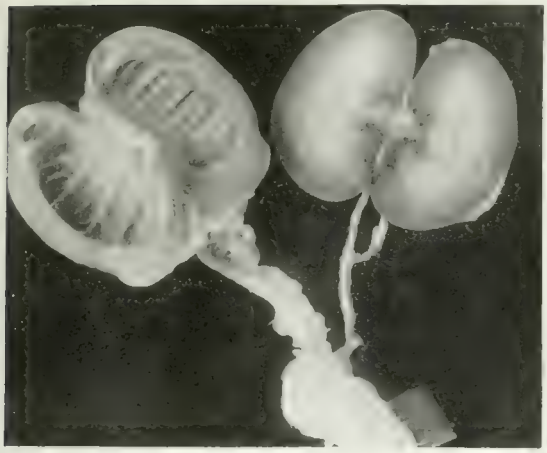

Fig. 13. Ureter ligated two weeks. Marked hydronephrosis.

Reid, by Keith and Pulford, and by Johnson. I wish to refresh your memories, however, by showing illustrations of the various degrees of renal involvement at different intervals following the obstruction (Figs. 10 to 15), in order to demonstrate how essential it is that prompt attention be paid to the ligation if there is to be hope of saving the kidney. It should be noted that dilatation of the ureter and kidney pelvis start fairly promptly after the ligation. Reid's work seems to show that the first dilatation is just above the site of ligation. We have not in our experiments seen it confined so definitely to the lower part, but have found it to be general throughout the ureter and kidney pelvis. As you can see from the sections, there are various grades of hydronephrosis up to the fourth or fifth week, at which time the kidney is seriously damaged, and often nothing of the cortex left but a shell (Figs. 14 and 15).

The ureter in all of these ligations has been tortuous, which explains why ureteral catheterization may be impossible even though the ureter has opened. Thus it seems evident that if one hopes to conserve the kidney the obstruction must be relieved, certainly within two weeks, as after that it may be irreparable. This has recently been demonstrated by Johnson who has shown that the functional test may return to normal in an animal whose kidney has been obstructed for no

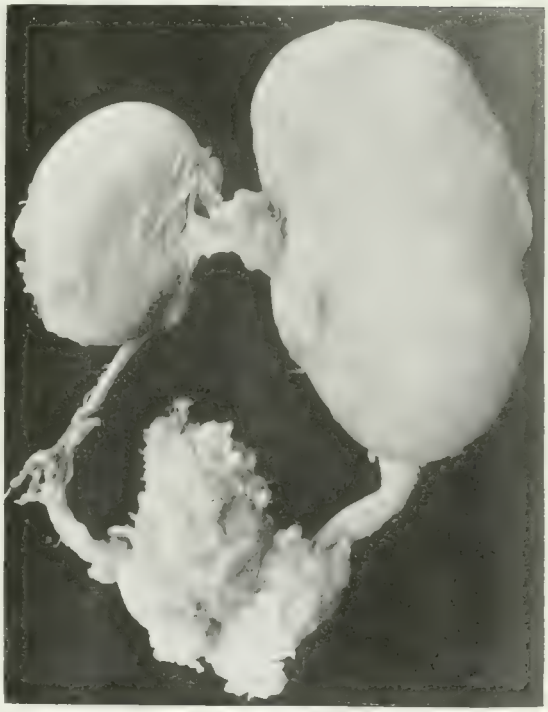

Fig. 14. Ureter ligated 4 weeks.

longer than two weeks. The longer the period of obstruction the slower the rate of recovery.

In a series of experiments which have been done to determine the nitrogen content of the blood following single ligation of the ureter, we have found that in some of these animals there is a gradual rise of the blood nitrogen content until the time the kidney is drained — which was usually the fourth day. Following this, there is a sudden rise, in some instances, but usually a very slight one. Then within 2 to 4 days after drainage the blood nitrogen drops to normal and remains so if the drainage is sufficient.

This restoration of function after a prolonged obstruction has an important clinical significance, and demonstrates to us how careful one should be in suggesting nephrectomy to patients whose kidney function may be extremely low in the face of retention. We should always try to relieve the retention conscientiously before attempting to sacrifice a kidney, as so frequently kidneys which

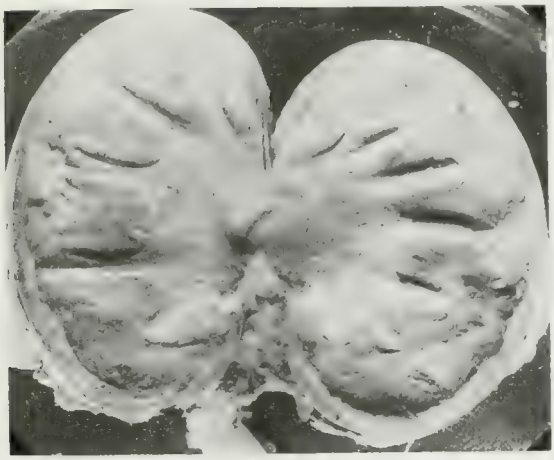

Fig. 15. Same as Fig. 14.

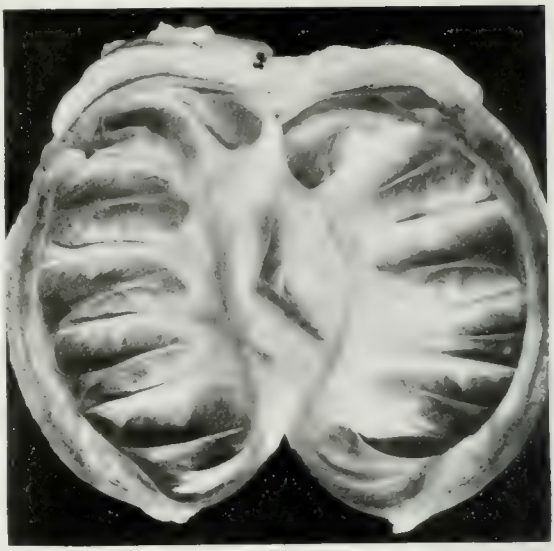

Fig. 16. Kidney at end of 6 weeks.

seem functionally hopeless have been restored after retention is relieved. Therefore, clinically, we must relieve a kidney of complete retention before the end of 2 weeks.

In double ligation, of course, one should drain promptly after the ligation is appreciated in order to save the life of the individual. In single ligation, however, the problem presents a different aspect. In this instance the life of the kidney alone is to be considered. Shall we allow the kidney to die unmolested, or shall we exert every effort to protect it? The difficulties in this phase of the question are manifold. In the first place since the symptoms may be insignificant, many ligations may pass entirely unappreciated both by patient and surgeon. If they are recognized and appreciated, the surgeon is confronted with these questions: Shall he propose to his patient that there is a surgical complication which she may never become aware of, and which may probably disturb her health but little if at all, if left unrelieved; or shall he suggest another operation which though attended with some risk and more suffering, will in all probability give her much greater renal capacity? Again, is there danger that another operation, several days after pelvic surgery, would be too hazardous? Are the results that we can offer commensurate with the danger and difficulties of the problem; and which phase of the problem presents itself as the most suitable avenue of approach for the ultimate relief of renal embarrassment and restoration of health?

We shall attempt to answer these questions in our summary. We feel entirely convinced that catgut will not be absorbed rapidly enough to protect a kidney against complete destruction, so that in double ligation a prompt response is necessary after the appreciation of a ligation. Our experiments and clinical observations seem to indicate that a ureter which has been ligated with catgut will eventually open sufficiently to allow complete drainage from the kidney, and that this opening takes from 6 to 8 weeks or more, during which time a kidney will be completely destroyed unless protected by drainage, either through the kidney or through the ureter.

Faced with the difficulties of deligating a ureter, such as reopening an abdominal wound and searching for a small tie in a pelvis imbedded with plastic exudate, and the ureter incorporated with the uterine vessels, with the consequent danger of hæmorrhage and the possibility of cutting the ureter with a resulting fistula — certainly a much more serious operation than a double nephrostomy — and with the same difficulty attending a ureterovesical anastomosis (with

the exception of hæmorrhage), we are of the firm belief that the safest method of protecting the individual is an immediate double or single nephrostomy.

We are impressed that dealing with single ligation, such as we propose, may not have as large a field of usefulness as it merits. In the first place, the diagnosis of single ligation may prove difficult, as the symptoms may be slight. If, however, a woman who has undergone pelvic operation complains of pain in the kidney, which is usually about the third day, and this kidney is found to be enlarged and palpable, not having been so beforehand, such symptoms are highly suggestive of ureteral ligation. If the patient's condition would warrant it, a ureterogram would clinch the diagnosis. It is then for the surgeon to decide whether it is better for the patient to allow the kidney to die or to try to protect it. It seems certain that no reputable surgeon would be embarrassed in making this situation known, provided there is a fair chance of saving the kidney. The danger of a unilateral nephrostomy should be extremely slight, as it can be done under local anæsthesia and certainly quickly under gas.

With such a fair chance of the ureter opening and the kidney healing in good condition, we believe that this should be the procedure. Granting that it may not be successful, even then the patient's ultimate condition is as good as it would have been had the attempt not been made, and we would have fulfilled our chief urological duty, namely an attempt to conserve the renal parenchyma.

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ABNORMALITIES RESULTING FROM THE REMAINS OF THE OMPHALOMESENTERIC DUCT

Report of Two Cases

By MOSES BARRON, M.D., Minneapolis
From the Department of Pathology, University of Minnesota

A MALE child, G. W., age 5, was admitted to the University Hospital on November 12, 1916, complaining of a persistent discharge from the umbilicus. The mother stated that she first noticed a slightly raised, raw surface at the navel several weeks after the birth of the child; nothing abnormal was seen at the time when the cord dropped off. A little later, a slight, bloody, odorless discharge appeared which irritated the skin immediately surrounding the umbilical depression. This condition persisted.

Examination at the hospital showed the presence of a small polypoid mass of granulation tissue at the umbilicus. This was bathed by a thin, blood-tinged, serous exudate. The surface of the mass was smooth and velvety and bled readily. The base was attached to the umbilical floor. There was no opening present on the surface, and neither fæces nor urine could be detected in the secretion. In order to determine whether a fistula existed at this point, the patient was given methylene-blue by mouth. Examination of the exudate revealed no trace of the dye.

The parents refused all operative procedures at this time, and the child was discharged from the hospital, unimproved, on November 21, 1916. When the parents realized that the condition was not getting any better, they brought the child for readmission on April 11, 1917. On April 14, the navel was excised through an elliptical incision. The peritoneal surface opposite the depression was smooth and showed no attachments. Healing of the operative wound was rapid and complete.

The specimen removed showed a bright red, velvety, pear-shaped mass (Fig. 1) attached to the lower margin of the umbilical depression by a broad base. The polyp measured 5 millimeters in diameter and 9 millimeters in length. In appearance it resembled exuberant granulation tissue. The surface was covered with a seromucous exudate.

A microscopic section at once made clear the true nature of the polyp. A section through the long axis showed dense bundles of hyalinized connective tissue at the base (Fig. 2). The mass proper revealed two distinct layers—an internal core consisting of irregular bundles of smooth muscle fibers and connective tissue, and a peripheral or glandular zone about 1 millimeter in thickness strongly resembling the mucosa of the intestine (Figs. 3 and 4). The surface was covered with a tall non-ciliated columnar epithelium. Villous, club-shaped masses projected from the surface. These were composed of loose connective tissue infiltrated with numerous leucocytes (eosinophiles, plasma cells, lymphocytes, and polymorphonuclears). Very many thin-walled blood vessels were present. The gland tubules, which composed this zone, opened on the surface between the villi. The tubules were lined with a single layer of low columnar epithelium and terminated in blind extremities deep in the loose connective tissue close to the muscular layer. The cells were sharply outlined; the cytoplasm took the basic stain; the nuclei stained deeply and were situated at the bases of the cells (Fig. 5). These cells were absent from the tips of the villi because of the ulcerative condition present. The lumina of the glands were empty. Some of the sections showed typical lymphoid follicles.

Thus the microscopic picture corresponded to the mucosa of the intestine with its characteristic columnar epithelial lining of the Lieberkuehn's glands which covered also the projecting villi. Some sections resembled very closely the structure of the appendix (Fig. 3). The loose cellular connective tissue surrounding the glands together with the muscular layer beneath this zone helped to reproduce a fairly characteristic picture of a section of the bowel. It was evident, therefore, that this umbilical polyp belonged to the congenital type of outgrowths that have their anlage in remains of the omphalomesenteric duct.

An interesting histological finding may not be altogether irrelevant at this point. In some of the serial sections studied, there were found tongue-like projections of squamous epithelium growing in from the margins of the skin, which abruptly separated the mucosa from the contiguous tissue (Fig. 3). A study of the leucocytic infiltration revealed a rather striking difference between the elements found in the loose cellular tissue of the mucosa and the denser connective tissue of the corium in the immediate vicinity; in the former, the infiltration between the glands consisted mainly of eosinophiles—a condition

Fig. 1.

Fig. 2.

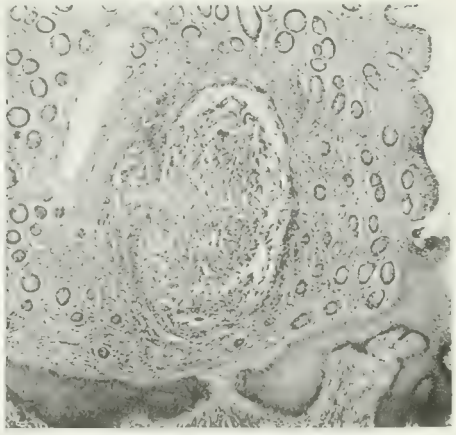


Fig. 3.

Fig. 1. Case 1. Photograph[1] of umbilical polyp cut in two.

Fig. 2. Case 1. Low power photomicrograph of a longitudinal section of the polyp showing the general structure. Note the connective-tissue core and the atypical villous projections. A patch of squamous epithelium attempts to cover a small area of the surface.

[1] Photographs by Henry W. Morris, Department of Pathology.

Fig. 3. Case 1. Higher power photomicrograph of a longitudinal section of the polyp taken from a different level. Note the absence of villi and the presence of very numerous glands of Lieberkuehn. In the center is a lymph nodule. This section resembles the vermiform appendix very closely. At the base are seen tongue-like processes of epithelium which almost completely separate the polyp, at this point, from the underlying structure.

so commonly seen in the intestinal tract—while in the latter, the lymphocytes and polymorphonuclears predominated with practically no eosinophiles present. This tends to show that the type of cellular infiltration resulting from an irritant is determined to a great extent by the character of the tissue acted upon. For, obviously, the submucosa and the adjoining subcutaneous tissue had been acted upon practically by the same kind and intensity of irritant, yet the two types of tissues attracted to themselves different types of cells.

The differentiation between this type of growth, possessing glandular structures, and the simple granulation tissue outgrowths of the umbilicus was first made by Kolazcek (1) in 1875. He describes a tumor of the umbilicus in a male infant 18 months old, which he calls an "entero-teratome." Microscopically, the tumor showed closely situated glands lined by columnar epithelium resembling Lieberkuehn's glands of the intestine. The surface was also lined with columnar epithelium. The center of the tumor was composed of bundles of non-striated muscle fibers. This author is probably the first one to suggest the relation of this type of tumor to a diverticulum of the "ductus vitello-intestinalis." He reasons that the character of the epithelium and the type of glands present cannot be satisfactorily explained in any other way. Just as a fistula from the bladder can originate through the urachus, so, in this instance, the tumor may have had its anlage in a retarded obliteration of the ductus vitello-intestinalis.

A year later, Kuestner (2), apparently overlooking Kolazcek's report, seems to have had great difficulty in explaining the microscopic picture of a small tumorous mass, similar to the above, removed from the umbilicus. He was surprised to find a core of connective tissue covered by a layer of granulation tissue in which were present numerous glands lined with cylindrical epithelium. He considers the structure an adenoma arising during the early fœtal development, either from the omphalomesenteric duct or, most probably, as he supposed, from the allantois. In a later article (3) he cites an additional case of "adenoma" in a series of 10 cases of umbilical tumors. Seven of the cases were simple granulation tissue polypi in infants 2 to 5 weeks old. Both of the cases of "adenomata" were in much older

infants. In reporting the second case, he changed his former view in regard to the origin of these tumor masses. He realized that it is not possible to explain the origin of a single layer of cylindrical epithelium from a structure like the urachus or allantois; however, he fails to make a positive suggestion as to its probable origin.

Kolaczek (4) criticizes Kuestner for calling these tumors adenomata, since they are not glandular new-growths but probably represent prolapses of a retarded normal embryologic retrogression of the ductus vitello-intestinalis. He concedes at the same time that he himself also was wrong in formerly naming them "entero-teratome." In suggesting their origin from remains of the ductus vitello-intestinalis, he established the status of this type of umbilical outgrowths that is universally accepted today.

That a number of these polyps are associated with remains from the allantois or urachus is shown by the large series of cases quoted by Cullen (5) from the literature. The diagnosis of this condition is generally fairly easy, because of the escape of urine from the umbilicus. In a few cases more urine passed by this route than through the urethra. In two cases cited (6, 7) a patent urachus was associated with a patent omphalomesenteric duct.

Meckel (8) was the first to point out that disturbances of the normal involution of the omphalomesenteric duct may lead to the formation of certain diverticula of the intestine which now bear his name. Although he taught this as early as 1812, it was not accepted until much later. In 1847 King (9) reported two cases of umbilical tumors which directly communicated with intestinal diverticula situated from 10 to 20 inches above the ileocæcal valve

Roth (10) discusses in detail the tumor masses in the vicinity of the umbilicus which have a congenital basis. He brings out the fact that the intestine is formed during the early weeks of development—at the time when the embryo separates itself from the underlying tissue. During the fourth week, the original vesicle is united to the umbilical region of the embryo by means of a narrow canal, the omphalomesenteric duct. This duct closes at about the sixth week, forming a fine, firm cord. Several weeks later the intestinal coils recede, and normally the connection between the intestine and the umbilical vesicle disappears. Any disturbance, however, of this normal involutionary process may lead to the formation of the relatively common Meckel's diverticulum, or any of its modifications. Roth classifies the sequelæ to abnormal involution under four main divisions:

1. Ordinary Meckel's diverticula—with free ends.

2. Adherent diverticula. The blind end is joined to the navel by means of a fibrous cord, the obliterated omphalomesenteric duct and blood vessels.

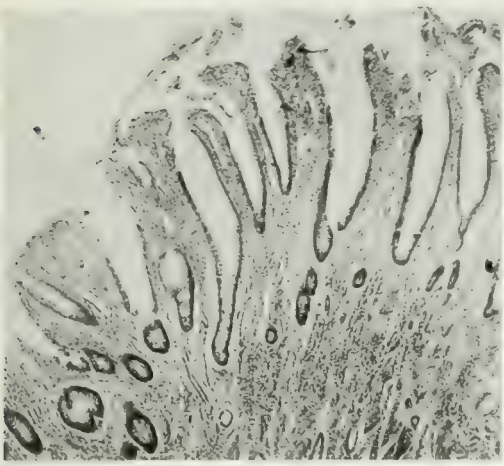
3. Patent diverticula. It is the common form of umbilical fistula. Secondary prolapse may result.

4. Enterocystoma. Retention cysts near the umbilicus which may or may not be connected with the intestine.

The solid pedunculated umbilical polypi are apparently not provided for in this classification; but Hektoen (11) unhesitatingly includes them in Group 3.

Their nomenclature as found in the literature is interesting. Kuestner (2, 3) called them adenomata; Kolaczek (4), enteratomata; Lannelongue and Fremont (19), adenoid diverticular tumors; Holmes (20), "warty or nipple-like tumors." They are also designated as "fleshy" tumors and mucous polypi. Hektoen (11) proposes the name "polypoid vitelline-duct remains." All of these growths present the following features in common: they are small, pedunculated, polypoid masses, having a smooth velvety surface and a reddish color. They secrete a viscid fluid and bleed readily. Microscopically, they show a central mass or core of connective tissue and smooth muscle fibers covered with a layer that almost exactly reproduces the mucosa of the intestine. In practically all cases, regardless of the age of the patient, their existence has been noticed since birth.

It is interesting to note that the first mention in the literature of the existence of patent diverticula associated with fistulæ is



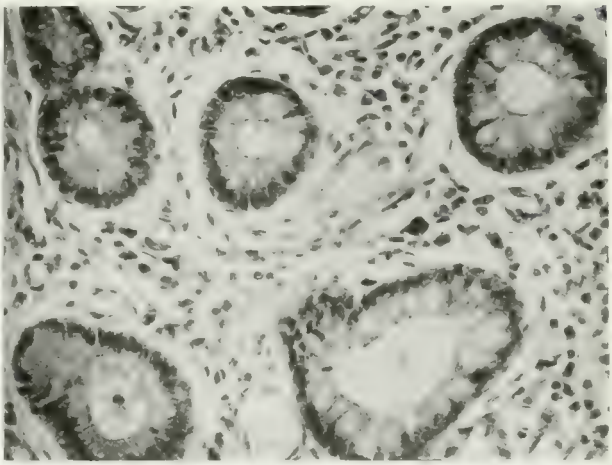


Fig. 4. Case 1. The atypical villi show ulcerations at the tips and small quantities of exudate on the surface. The crypts of Lieberkuehn are well shown.

Fig. 5. Case 1. High power photomicrograph showing a small group of Lieberkuehn's glands cut transversely. The loose cellular stroma shows thin-walled blood vessels and infiltrated leucocytes, many of which are eosinophiles.

not through the primary report of cases possessing demonstrable ducts leading to the intestine, but is rather incidental to the extraordinary observation of seeing living worms escape from the navel. Bottini (12) noticed six round worms, the ascaris lumbricoides, escape through the navel of a 10 year old boy suffering from gastro-enteritis. Nicolich (13) mentions the escape of similar worms from the umbilicus of a woman 25 years old. Bedel (14) reports his observations in the cases of two boys. Siebold (15) cites two cases from the literature and reports a case of his own in which tapeworms—tænia solium—were seen to escape from the umbilicus. His own case was that of a man 22 years old who suffered from a "suppurative umbilicus." Fæcal material was never seen to escape through the opening, and even the worm segments appeared to be clean and free from fæces. In these two cited cases, however, fæcal fistulæ were present. Many cases of this type are found in the literature.

Tillmanns (16) reports a unique finding in a case of umbilical tumor. A mass about the size of a walnut, apparently covered by mucous membrane, was present at the umbilicus of a boy 13 years old. An acid mucoid secretion flowed from the tumor. This secretion was increased by stimulation through handling, so that as much as 2 cubic centimeters could be collected in a quarter of an hour. The fluid was nearly always acid, and contained a ferment which digested fibrin. Tillmanns performed a number of tests with the fluid, the results of which led him to conclude that the secretion, since it contained acid and pepsin-like ferment, must be a product of *gastric* glands. The microscopic examination of the excised tumor showed bundles of smooth muscles and connective tissue in the center, covered by a layer of mucosa and submucosa Some areas suggested the picture of the pyloric end of the stomach, while other parts were more like the intestinal mucosa. Most of the glands were atrophic. Weigert saw the sections and pronounced the tissue as being most probably related to the stomach wall. The author's explanation, therefore, as to the origin of this tumor is that the navel included a pyloric diverticulum of the stomach in a manner similar to its more frequent inclusion of a Meckel's diverticulum of the small intestine.

Heukelom (17) disagrees with Tillmanns' conclusion regarding the origin of the tumor. Neither the character of the glands nor their secretion, he thinks, can definitely establish their origin. The character of the epithelium often becomes changed in those portions of Meckel's diverticula which become constricted off and separated from the main outpouching.

Fig. 6.

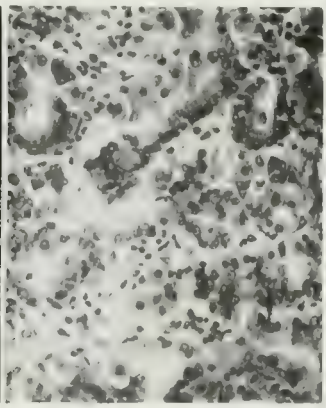


Fig. 8.

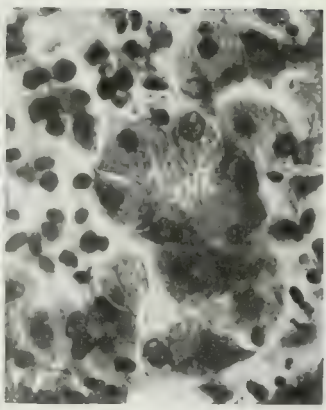


Fig. 9.

Fig. 6. Case 2. Photograph of specimen removed at autopsy as an accidental finding.

Fig. 8. Case 2. Photomicrograph of section taken through the distal severed portion of the lumen. Note the large triangular, circular, and irregularly elliptical cells possessing a moderately dense cytoplasm and well-defined deeply-staining nuclei. These cells take a deep eosin stain and are analogous to the "parietal" cells of the fundus of the stomach. Near the lower edge and to the left of the mid-line is a typical gland-like structure, showing these "parietal" cells together with the smaller, more deeply staining "chief" cells. Near the left edge, just below the middle, there is seen one of these acid cells with two nuclei. Many acid or "parietal" cells are seen scattered through the stroma. There is a dense leucocytic infiltration present.

Fig. 9. Case 2. High power photomicrograph of same section as in Fig. 8.

Not infrequently the glands in such constricted portions closely resemble those of the gastric mucosa histologically. He also states that even the acid secretion is no criterion, because the secretion of the intestinal glands prior to the establishment of the biliary flow is acid. He, therefore, believes that an early constricting off (*Abschnuerung*) of the diverticulum results in a glandular structure which has an acid secretion and microscopically resembles the gastric mucosa. A later constriction (*Abschnuerung*), on the other hand, results in the histologic picture of the small intestine with its Lieberkuehn's glands and goblet cells. The secretion in such a case is alkaline.

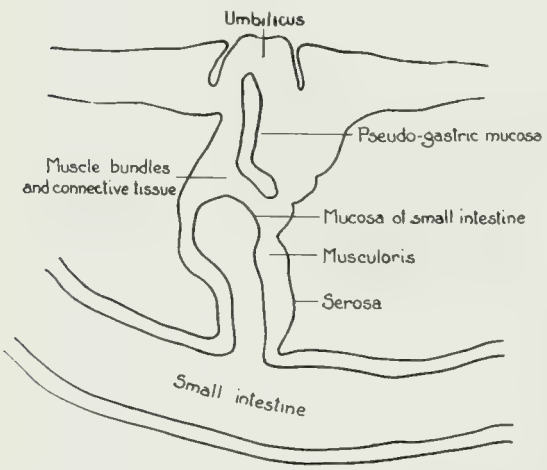


Fig. 7. Diagrammatic sketch of a longitudinal section of specimen from Case 2. It shows the separation of the distal portion of the lumen of the Meckel's diverticulum from the main portion by a connective-tissue septum. The proximal end is continuous with the lumen of the small bowel. The severed portion of the cavity is really a small cyst, communicating neither with the proximal diverticulum nor with the skin surface.

Heukelom's view relative to the origin of diverticula presenting gastric mucosa has been accepted by many authorities (Cullen, 18, and others), and is in accord with the histologic finding in a necropsy specimen which I studied.

This specimen (Fig. 6) was obtained at an autopsy as an accidental finding, in a case of a young man 29 years old, who died from a fractured skull. It showed a narrow Meckel's diverticulum possessing a thick cord-like attachment to the abdominal wall in the region of the navel. The navel itself appeared normal.

On probing the narrow lumen leading from the intestine into the cord, the cavity was found to extend for a distance of about 5 centimeters, where it abruptly ended in a blunt saccular dilatation about 1 centimeter in diameter (Fig. 7). Examination of the apparently solid remaining portion of

the cord revealed a small slightly curved cylindrical cavity measuring about 2.5 centimeters in length and averaging 2 millimeters in diameter. It was separated from the proximal diverticulum by a thin connective-tissue septum. The narrow lumen extended outward to a point just within the knob-like protuberance of the navel but did not open onto the surface (Fig. 7). The umbilical depression was normal.

The microscopic studies of the two cavities proved of unusual interest. Sections of the proximal one communicating with the intestinal canal showed the typical structure characteristic of the small bowel with its muscular layers and its mucosa possessing Lieberkuehn's glands and villi. The glands and villi were covered by a single layer of columnar epithelium containing goblet cells. But the sections of the distal canal revealed an entirely different histology. Instead of the aforementioned intestinal mucosa usually seen in Meckel's diverticula, there was present a picture bearing a very evident resemblance to the gastric mucosa. Throughout the reticular structure were scattered numerous epithelial cells disposed in typical gland-like arrangements, but also present singly, in small groups and cords (Figs. 8 and 9). The striking feature of these epithelial cells was that they comprised two distinct types: one a large cell, rich in cytoplasm, irregularly oval or triangular in shape, possessed a single well-defined nucleus or occasionally two nuclei, stained deeply with eosin, and altogether corresponded to the acid secreting "parietal" cells of the fundus glands of the stomach; the other, a smaller cell, irregular in shape with a single nucleus, took the hæmatoxylin stain and corresponded in general appearance to the chief or peptic cells. The "parietal" cells were situated close to the "basement membrane" of the glands but many were also extraglandular and lay free in the stroma. Many of the cells were 15 to 20 micra in diameter. The free inner surface of the mucosa was ulcerated and the epithelial lining was absent. The coarse stroma between the glands and groups of epithelial cells was infiltrated with lymphocytes, plasma cells, eosinophiles and polymorphonuclear leucocytes. Beneath this, there was a submucosa of loose connective tissue beyond which there was a denser layer of hyaline fibrous connective tissue containing small bundles of non-striated muscle fibers. It was, therefore, obvious that in structure, arrangement, and staining characteristics of the epithelial cells, there was a marked resemblance of this tissue to the mucosa of the fundus of the stomach.

The study of this specimen conclusively demonstrates that umbilical anomalies, presenting a structure which resembles the mucosa of the stomach, need not have their origin in remnants of gastric diverticula or displaced patches of gastric mucosa. Indeed, it is very probable that such relations never exist. In all of the similar cases reported in the literature (Tillmanns, 1887; Van Heukelom, 1888; von Rosthorn, 1889; Reichard, 1898; Weber, 1898; Lexer, 1899; Stroda, 1903; Minelli, 1905; Denucé, 1908) not one presented convincing evidences that the anomaly had its origin in or was in any way associated with the stomach wall. The conclusions of Tillmanns (16) and others were mere conjectures arrived at from histological appearances only, and naturally proved the easiest explanation. But the specimen here studied, as well as the case reported by Lexer (21), shows very clearly that different portions of the same diverticulum of the intestine may possess totally different histologic appearances, and that a portion completely separated from the intestinal lumen by a septum may present a picture closely simulating the gastric mucosa. Van Heukelom's view, therefore, is completely corroborated by the findings in this case. The distal cavity was severed perhaps from the main diverticulum very early in the development of the ovum, prior to the establishment of the flow of bile and the alkaline secretions. This resulted in a glandular structure which histologically resembles the mucous membrane of the stomach and which functionally probably had produced an acid secretion.

The second case discussed in this paper, although it presents an umbilical anomaly with a structure resembling the gastric mucosa, belongs to the same class of congenital abnormalities as the first case, having developed from the remains of the omphalomesenteric duct.

SUMMARY

1. Umbilical inclusions of remnants of the omphalomesenteric duct are not at all uncommon. Most of the "umbilical granulomata" are probably structures of this type.

2. Umbilical polypi, presenting gastric mucosæ, undoubtedly originate in remnants of the omphalomesenteric duct and not from gastric diverticula. The histological and functional characteristics of these anomalies are probably determined by the stage of

fœtal development at which time the constriction or *Abschnuerung* occurs.

3. The milieu is an important factor in determining the type of cells called forth by any given stimulus.

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GANGRENE OF AN ECTOPIC KIDNEY FROM TWISTED PEDICLE

By J. LOUIS RANSOHOFF, M.D., F.A.C.S., Cincinnati

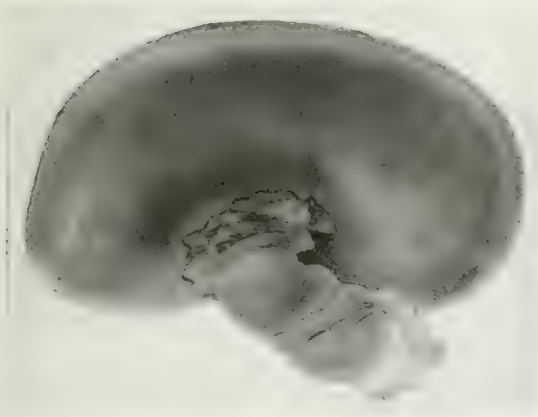
ECTOPIC kidney is in itself not of sufficient rarity to warrant the report of a single case. It is in fact not an uncommon condition. Naunam found 21 cases in 10,177 autopsies. Guizzetti and Pariset reported 18 cases in 20,000 autopsies. Dorland, in 1911, collected 121 clinical cases. This condition is, as a rule, accidentally discovered during an operation undertaken for some other surgical condition.

Ectopic kidney, which is a true congenital anomaly, must be sharply differentiated from movable kidneys of all degrees.

Ectopia of the kidney is an arrest in the ascent of the kidney from the pelvis to the position it occupies in the normal adult life. The reason for this arrest in ascent is one of conjecture, but in all likelihood it is caused by the anomalous origin of the renal artery from the common or external iliac. In the case of sacral ectopia, the arrest occurs during about the seventh week of embryonal life. With the newer methods of renal diagnosis, particularly pyelography, the diagnosis of ectopic kidney is not infrequently made prior to operation, particularly when symptoms point to a disease of the kidney on this side.

In ectopic kidney, the artery is short and comes down from the nearest large trunk, either the aorta or the common iliac. The pelvis and ureter are usually on the anterior surface of the kidney, retaining their embryonal relation. The ureter is short and enters the bladder in the normal position. The ectopic kidney is as a rule fixed in its position, by both its short artery and its complete retroperitoneal location.

Case. Female, age 12, referred by Dr. A. H. Carr. Nothing in the past or family history is germane to the present condition. For the past three weeks, the child has complained of pain in the lower abdomen which has at times assumed a colic-like character. There has been constipation. The child has eaten and slept well and has attended school. There has been no vomiting and no history of sudden strain or injury. On November 21, the pain became more severe and there was one attack of vomiting. On



November 22, 1919, 4 p.m., the child was admitted to Jewish Hospital.

Examination on admission revealed a well developed and nourished child. The heart and lungs were normal. The temperature was 99.2°, pulse 100. Leucocyte count 9,000. The urine was clear, light amber; specific gravity 1020; no albumin, sugar, casts, or blood. There was a slight rigidity of the lower recti muscles, particularly on the right side and a moderate degree of tenderness. Diagnosis: subsiding subacute appendicitis. Operation, Jewish Hospital, November 24, 1919, gas ether anæsthesia, gridiron incision. On opening the abdomen a moderate amount of blood-stained serum escaped from the pelvis. A pelvic examination revealed a tumor mass in the hollow of the sacrum. The incision was enlarged and the patient placed in the extreme Trendelenburg position. The tumor was delivered into the wound and proved to be a gangrenous ectopic kidney entirely intraperitoneal. The pedicle was twisted from the left to the right three and one half times. Adherent to the anterior surface of the kidney was the right tube, also gangrenous. The ureter came from its normal position and was about 3 inches in length. As near as could be determined the artery arose from the common iliac.

Examination revealed a normal kidney on the left side and an empty pouch in the normal kidney position on the right side. The pedicle was tied and the kidney removed, the tube being cut off close to the uterine horn. No trace of the right ovary could be found. The left ovary was normal. The appendix was moderately inflamed and was removed in the usual manner. Recovery uneventful.

The attachment of the tube can be easily explained by its proximity to the kidney during fœtal life. There are, however, several features of this case which are entirely inexplicable. The complete intraperitoneal position of the kidney with mesentery containing the artery and ureter, is difficult, if not impossible, to explain. In the absence of any fall or sudden strain, the twist may perhaps be explained by a sudden peristaltic movement of the sigmoid, which started the rotation of the kidney. A rather extensive search of the literature has failed to reveal a similar case.

Looking back on this case, it might have been possible to make a diagnosis had a rectal examination been made. The symptoms, however, pointed so clearly to an appendicitis, that further examination seemed unnecessary.

TOXIC GOITER FOLLOWING EPIDEMIC INFLUENZA[1]

By C. A. ROEDER, M.D., Omaha

THE etiology of any type of enlargement of the thyroid is still a mystery and the pathology was a hopeless puzzle until Wilson and Plummer placed it in a more definite clinico-pathological basis. We feel that the nodular or adenomatous and hyperplastic goiters are frequently, if not always, caused by infections from various foci, but not many records are available demonstrating the close relationship between an acute and more general infection and toxic goiter. The past epidemic of influenza left more various complications than any other known infection, and it was our privilege to observe three toxic adenomatous cases and five exophthalmic (hyperplastic) cases of goiter, all developing rapidly and immediately following the infection.

Case 1. Toxic adenoma. Mrs. W., Pisgah, Iowa. Age 38, married, 2 children. The patient has had a nodular goiter since she was 20. The goiter had been barely noticeable and had produced no

[1] Abstract of a paper read before the Association of Residents and Ex-Residents of the Mayo Clinic, October 8, 1920.

symptoms. Two months ago the patient had epidemic influenza without pneumonia, and four weeks after onset she became very weak and had an enlargement of the right side of the thyroid gland. One week later a marked psychosis developed, called by the neurologist toxic psychosis, with pulse 120-140. Removal of this adenomatous mass, which was degenerating and of an intense greenish color, relieved the patient within a few days and she made a steady and complete recovery.

Case 2. Toxic adenomata. Mrs. J. H. B., Omaha. Age 48. The patient has had a nodular goiter for 19 years, with no symptoms. She had epidemic influenza in November, 1918. This was followed immediately by nervousness, tachycardia, tremor, increasing weakness, very moist skin, and œdema of the face and ankles. She presented an enlarged nodular gland, pulse 140, no eye signs; glycosuria; blood pressure 120-90. Double resection was done and degenerating adenomata removed. She made a rapid recovery.

Case 3. Toxic adenomata. Mrs. C. Z., Omaha. Age 42. The patient has had a nodular goiter for 20 years, with no symptoms. She had epidemic influenza in November, 1918. Since then there has been no change in the size of the gland but her illness was immediately followed by increasing weakness, tachycardia, nervousness, dyspnœa and moist skin. The blood pressure was 120 and 80; albuminuria; eyes staring but not protruding. Double resection was done and degenerating adenomata removed. She made a rapid and complete recovery.

Case 4. Hyperthyroidism. Miss W., Petersburg, Nebraska. Age 24. The patient had had epidemic influenza without pneumonia 4 months before consultation. One week after getting up she noticed dyspnœa, nervousness, tachycardia, and increasing weakness. All symptoms for past 3½ months gradually increased and 3 weeks ago she noticed enlarging thyroid for the first time. Pulse 120-140; Graefe sign; moist skin. Double ligation produced only very little improvement. Both inferiors were then ligated. At present she is improving.

Case 5. Hyperthyroidism. H. C. L., Omaha. Age 37. The patient had had influenza without pneumonia in November, 1918. Three weeks after getting up she noticed increasing nervousness, weakness, and tachycardia with attacks of diarrhœa, at which time she passed blood. A goiter was first noticed about 8 weeks after the onset of the influenza. No exophthalmos was present but there was a moderate Graefe. The skin was stained intensely dark, resembling Addison's disease. Pulse 130-160. Single ligation and resection were done. Pathology—hyperplastic thyroid. Good recovery.

Case 6. Hyperthyroidism. P. L., Hampton, Nebraska. Age 20, single, female. For 2½ years the patient had had a small nodule in the thyroid which produced no symptoms. She had epidemic influenza in November, 1918. One week after getting up she noticed enlarging of the neck and nervousness, sweating, and palpitation, soon followed with loss of weight. The eyes became more prominent 2 months after onset. Examination showed pulse 140, skin moist, tremor, and moderate exophthalmos. Double resection. Pathology—hyperplastic thyroid. Recovery.

Case 7. Hyperthyroidism. Mrs. L. C. P., Grenora, S. D. Age 29. A goiter was first noticed immediately after epidemic influenza in November, 1918. Since then the patient has suffered from increasing nervousness, weakness, tachycardia, and loss of weight. There is no exophthalmos but a marked Graefe. Thyroid enlarged (2), uniform. The skin was very moist. Double resection. Pathology—hyperplastic thyroid.

Case 8. Hyperthyroidism. Mrs. D. A., Omaha. Age 32. The patient had an attack of epidemic influenza in November, 1918, which was followed immediately by nervousness, dyspnœa, headaches, tachycardia. The symptoms gradually increased and the patient had spells of vomiting and diarrhœa. The thyroid was moderately enlarged and marked thrills, bruit, and a Graefe were present. There was no exophthalmos; pulse 130, skin moist; extreme hunger; glycosuria. Double resection. Pathology—hyperplastic thyroid. Good recovery.

Out of these 8 cases 3 had adenomata which suddenly became very toxic. The 5 cases of hyperthyroidism had their onset definitely following influenza. The toxæmia from the 3 cases of adenomata may have been present before the epidemic but it was very slight, as the blood pressures were all low and no other changes were evident. Since this paper was written I have had five more cases, three hyperplastic (exophthalmic) and two toxic adenomata all coming on following epidemic influenza.

DIVERTICULUM OF THE DESCENDING COLON CAUSING HYDRONEPHROSIS

By GEORGE F. STRAUB, M.D., Honolulu, Hawaii

CASES of diverticulum of the colon, and of its descending part in particular, are so rare as to merit the publication in detail of each individual case.

Mrs. C. D. R., age 51 years, married in 1896, was admitted to Queen's Hospital June 25, 1918. The patient had never been ill before her marriage. The menses which had always been regular in quantity and quality, stopped in 1917. The climacterium passed without any disturbance. She had no children. No pathological discharge had been noticed at any time. A number of times she had the os dilated for sterility with no effect. She had never been pregnant. Bowel movements and urination were normal with the exceptions referred to below.

About 6 months after marriage the patient began to ail with, what she thought to be, "malarial" symptoms. She had a normal temperature in the morning, a rise to 102° and more in the evening, followed by very profuse sweats. She does not remember whether or not she had chills. There was only a slight feeling of fullness at times in the left flank, but no other local symptoms of any kind. These symptoms came on in the form of frequent attacks lasting a week or so and, in the beginning, did not cause much weakness or discomfort aside from forcing the patient to bed in the afternoon. In March, 1897, an exploratory operation was advised by the then attending physician, although there was no pain on pressure in the abdomen, no tumor palpable, vaginal examination was negative, but the patient became more and more exhausted through these repeated attacks of fever and discomfort in her left side. One morning, a few days before the operation, she was surprised by the free passage of a great deal of urine containing a large quantity of a gangrenous-looking and smelling fluid. The bladder was washed frequently, and on March 13, she was operated upon by laparotomy, the operation lasting 2½ hours. All she was told was that a great amount of pus, had been found and that no organs were removed. The incision healed only partly, and a large quantity of pus and, at times, urine came through the wound. Since that time tenderness developed in the left flank radiating toward the back under the ribs. During her slow reconvalescence she decided to go to San Francisco, and on July 5, while on board of ship, she took a Seidlitz-powder, which caused a great quantity of gas, together with some fæces, to escape through the wound. Another "long operation was done, adhesions broken, nothing removed, the source of the trouble not located and the abdominal cavity drained through the vagina." There were frequent irrigations. The urine at that time and for a long time after contained considerable heavy slimy matter. In December there was only a small opening left of the incision, still secreting, and requiring much dressing. The incision healed and opened alternately until October 1899, when, after a hard chill and temperature, a quantity of pus was discharged and in a short time the incision closed never to open again. After this the patient developed peculiar attacks, which came and went every few weeks. She had occasional high fever and acute pain, in fact was never free from discomfort in the left upper abdomen and loin, the acute attacks being generally relieved *by either a flood of urine or by passage of considerable gas and stool by rectum.*

Examination. The chest was negative. The abdomen was negative except for a palpable mass around and below the left lower kidney-pole, 4 inches laterally from the umbilicus, immovable on palpation and changing on percussion after inflation of the colon, painful on pressure. Vaginal examination was negative. Leucocyte count: 11,800, 82 per cent polymorphonuclears. The urine was absolutely negative on repeated examination. An X-ray examination of the stomach made in the course of an examination by another physician in February, 1917, showed a normal stomach-series, a small diverticular projection above the colosigmoidal junction, a cæcum of the fœtal type and a residue in the appendix after 4 days.

Cystoscopy. June 26, 1918. The bladder was found to be normal except for a slight transposition of the trigone toward the left, the left ureter apparently being pulled upon in an upward direction. The ureteral orifices were normal. Spurt normal. Ureteral catheters on both sides could be passed up to the kidneys without difficulty. Indigocarmine and phenolsulphonephthalein tests showed 1 minute's delay on the left side — 5 and 6 minutes respectively — were otherwise normal in quality and quantity except for a slight diminution on the left side — 9 and 7 per cent respectively. The capacity of the left kidney pelvis was 52 cubic centimeters, that of the right normal. Bacteriological examination of the urine was negative.

X-ray examination of urinary tract. A plain X-ray of the kidneys was negative. In the region of the left ureter below the sacro-iliac joint, there was a small shadow, possibly a concrement, although the catheter did not meet with obstruction; but a subsequent X-ray, June 28, did not show this shadow any more.

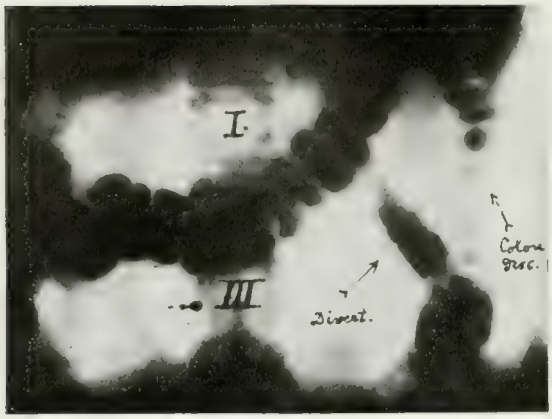


Fig. 1. Colon after bismuth meal. The diverticulum is demonstrated pointing toward the first lumbar vertebra.

Fig. 2. Roentgenogram taken after bismuth enema with the diverticulum filled to capacity. Pyelogram made simultaneously shows relation of ureter and kidney pelvis to the diverticulum. I, II, III, lumbar vertebræ.

Pyelogram. The right side was normal. The left kidney-pelvis showed moderate enlargement and indistinct outline in its lower pole. Another pyelogram taken on July 2, of the left side only in combination with a bismuth-enema showed the kidney the same as on June 26 (Fig. 2). The descending colon presented a diverticulum pointing toward the right side, upward and ending in the region of the lower pole and pelvis of the left kidney. After 24 hours a residue was left in the diverticulum in the same position, but much less intense than on the day before.

X-ray examination of the colon. June 30. This picture, taken after a bismuth meal, had already shown the same diverticulum, but not as plain as the enema (Fig. 1).

Diagnosis. Diverticulum of the colon descendens causing intermittent hydronephrosis of the left kidney.

Operation, September 14, 1918. Dr. Judd assisting. A left pararectal incision, 4 inches long, was made over the descending colon. Before opening the peritoneum a hazelnut-size area of thick pus was encountered — evidently the trace of an old threatening perforation — behind which the colon descendens was adherent to the peritoneum. On the posterolateral side of the colon the diverticulum was dissected out of dense adhesions. Its base was about 2 inches in diameter. In its course it ran behind the colon pointing upward and toward the median line, in a general direction toward the lower pole of the left kidney, for about 2½ inches, retroperitoneally. The tip of the diverticulum had perforated and was continuous with a retroperitoneal fistulous tract another 2½ inches long and 1 inch wide ending near the left kidney pelvis and around the left ureter. The diverticulum was trimmed off, inverted by two catgut and one linen suture, and this suture line covered with a fat flap available. The sinus was enlarged, curetted, the peritoneum closed, and an extraperitoneal 10 inch long rubber drain left in place, running from the front incision out through a counterstab near the lower kidney-pole. The rest of the incision was closed in layers.

The patient made an uneventful recovery and is now in excellent health.

Aside from the diagnostic interest, which this case offers, it is mainly the history and pathology, which compels the attention of the medical mind. In reviewing the history from its very beginning, 22 years ago, it is possible to distinguish three distinct stages of the process. First we see the patient pass through a rather uncharacteristic and vague period of chronic diverticulitis, which may be explained by the fact that the diverticulum had a retroperitoneal location. This stage ended by perforation of its apex into the surrounding tissues, and the formation of one or more abscesses gravitating toward the pelvis with resulting fistulæ and perforation into the urinary tract. The still persisting diverticulum and its fistulous extension as shown at the time of the last operation finally led to the third and most interesting period: the one of the intermittent hydronephrosis. There is no doubt in my mind that the whole symptomatology of this case was caused by this one condition in its various stages and forms. And from the operative findings it is also absolutely evident that the diverticulum in question was a true congenital diverticulum, perhaps of the ancestral variety, if we wish to follow Cahier's classification.

NARCOSIS TREMOR AND ITS TREATMENT

By Dr. TORSTEN RIETZ, Västervik, Sweden

THERE is not a word to be found, either in the better textbooks on surgery or in special works on general anæsthesia, concerning the tremor which sometimes appears during narcosis. As it is an exceedingly disturbing complication and hinders the surgeon while operating, and moreover as I believe I have found a method by which it can be overcome, I will give a short account of my experience in the hope that my method may help others.

Narcosis trembling resembles very much a series of frequent rhythmic muscular contractions. These are sometimes so violent that they are almost mistaken for clonic cramp. The trembling attacks chiefly the lower extremities, but sometimes the trunk is also involved, at least the lower part. The frequency and severity of the spasm remind one most of the findings in cases of intense tremor, of epileptic attacks, or spasms from other cortical irritation.[1] Usually the trembling comes on suddenly, without warning, and as a rule immediately reaches its full intensity; then, after a longer or shorter period it disappears as suddenly as it appeared. There are no single detached spasms later, such as one sees in eclampsia or epilepsy. The phenomenon always appears as a series of rapid spasms at regular intervals. The severity, however, varies in different cases as well as in the same patient during a given narcosis; it may happen that at first the trembling is very slight but that later, attacks become more violent. Sometimes the trembling appears only as slight, rapid, spasmodic jerks lasting for a fraction of a minute. In some cases the trembling continues as long as 5 minutes and in some cases even longer, and this, it is readily seen, is a great hindrance to the surgeon in performing the operation. In several cases we were able to check the trembling by means of the technique which is described below.

[1] Among the many forms of tremor which have been described are also the groups, cerebral tremor and the so-called cerebral form of toxic tremor.

Before outlining my method, however, I wish to sum up briefly the results of my investigation regarding narcosis trembling or tremor.

Thirty-three cases in all have been observed during the years 1912 to 1919. With two exceptions only, the patients were men, that is there were 31 males and 2 females. Most of the patients were between the ages of 25 and 40, but this group is, in any case, the one most frequently found among our hospital patients. Attaching due importance to this circumstance, we find that the cases are pretty evenly distributed over the ages 16 to 68 years. A predisposition for a certain age does not, therefore, exist, but on the other hand narcosis tremor has not been observed in children under 16.

Neither the hospital records nor the objective examination of the patient has afforded any exact means of determining the factors which may possibly be considered as favoring the appearance of the above described spasms. The patients did not show more than other patients extreme agitation and there was not present confusion or excitement at the time the patient was given the anæsthetic. Then, too, in several cases the narcosis tremor did not appear until toward the end of the operation or even until the patient was returning to consciousness. As to the time of appearance there is no regular time as is shown in the following summary:

	Cases
Spasms observed at the beginning of narcosis	3
Spasms observed at the beginning and middle of narcosis	2
Spasms observed at the middle of the narcosis	1
Spasms observed at the middle and end of the narcosis	1
Spasms observed at the end of the narcosis	6
Spasms observed during whole narcosis	1

The technique used in administering the anæsthetic does not seem to make any difference nor does the position of the head, etc. In 28 cases ether was given, in 2 a mixture of chloroform and ether (as regards 3 patients there is no note "narcosis with ether" but

there is reason to believe that such was given, which would give 31 and 2 mixed anæsthesias). The quantity of ether or chloroform used does not assist in determining the cause of the spasm nor does the duration of the narcosis The largest quantity of anæsthesia used was 250 cubic centimeters of ether and the longest period was 2 hours. These figures are, however, exceptional and the average quantity and time would be about 120 cubic centimeters in 35 minutes. It has often happened that several operations have been performed, one after the other and that also other patients have been anæsthetized out of the same bottle as the tremor cases and the other patients have not exhibited narcosis spasm. The ether is kept and tested in such a way that there is no reason to assume adulteration or decomposition of the anæsthetic.

As was to be expected, the part of the body on which the operation was performed was irrelevant to the appearance of the tremor; thus the spasms cannot possibly be regarded as a sort of so-called reflex-epilepsy originating in a definite part of the body. On one occasion in an operation for varicose veins, it was observed that the spasms chiefly affected the leg on which the operation was being performed. This circumstance, however, does not seem to be of any significance and can be partially explained by the fact that the other leg was kept in a fixed position.

Because of the character and course of the attacks in our series, we feel justified in comparing them with the rhythmic contractions which occur in a number of other conditions and which are considered to depend on an abnormal irritation, influencing in some manner the motory courses. It is true that this is generally believed to occur in the cortex of the brain, but as to the nature of this disturbance, we know very little. It is outside the scope of this paper to discuss the various theories regarding this question.

The narcosis tremor must be due to an irritation which is produced in some manner by the narcotic which is conducted to the brain through the circulation of blood.

What then is the reason that such spasms do not always occur, but appear only in a few cases?

As shown above, the type of case and the mode of administering the anæsthetic do not throw any light on the subject, except to show that a marked predisposition exists in men. We are, therefore, forced to assume that the abnormal irritation which produces these motory symptoms has some connection with a special sensitiveness in these patients. This assumption is strengthened by the fact that in certain individuals and certain conditions there is a predisposition to epileptic attacks. This varying sensitiveness renders it impossible ever to know with certainty whether epilepsy will appear or not, for instance after a depression fracture of the skull, etc.

On the hypothesis that narcosis tremor is the result of an abnormal irritation of the brain produced by the anæsthetic which is conducted thither by the blood, I have endeavored to overcome this phenomenon. To eliminate, at least for a moment, the influence of the irritated motor centers, during an operation on a boy of 16, I pressed, for a few seconds, on the neck in the fossa carotica. The result was evident at once; the narcosis tremor disappeared as by magic. It appeared again, however, when the pressure was removed. Renewed experiments had precisely the same effect. When pressure was again applied for a somewhat longer period (about one quarter minute), the spasms ceased definitely.

Although on some occasions the manœuvre had doubtful results or none at all, continued observations still showed that the measure was of value. As regards the effect of pressure, the cases may be divided into three groups. The first includes those patients in whom compression gave a positive result. By this I mean that the spasms immediately decreased in force, or ceased altogether after the application, by means of a regular grip, of pressure on the designated spot. Generally speaking, in these cases, the reaction on the part of the patient, in the form of a weakening or cessation of the disturbing spasms, is so prompt that one is left in no doubt whatever as to the effectiveness of the measure. If the pressure is applied for only a short time, the tremor usually returns; a somewhat longer application of pressure on the other hand stops the tremor definitely.

If, from the beginning, only a slight pressure is exerted, there is merely a diminution of the trembling. If the pressure is decreased still more the spasms at once become more violent, so that the pressure can be regulated by the intensity of the jerks. I remember only one case, that of a man of 55, in whom there was a distinct gradation from less severe to complete cessation of the spasms. Another peculiarity was also observed in this case; the tremor which, in the beginning of the narcosis, was less pronounced was at this time but slightly affected by pressure and showed a diminution only in the extent of the phenomenon. The trembling gradually increased in intensity, but could now be stopped by means of pressure. Cessation of the trembling, however, lasted only as long as the pressure was maintained. It was noticed that the quadriceps femoris and the muscles of the calf were considerably contracted during the period of cessation of the spasm.

The other group includes cases in which the results were not decidedly positive, and the narcosis spasms possibly ceased of themselves, or circumstances rendered the investigation incomplete.

Finally come the cases in which compression was ineffective. In the 33 cases mentioned the measure was used 29 times; 4 patients had short spasms which ceased of themselves and did not call for treatment.

The other 29 cases fall into 3 groups as follows: In Group I, the effect was certain in 19 cases; in Group II, the effect was uncertain in 5 cases; in Group III the effect was nil in 5 cases.

In no way does the result vary in so far as the degree of unconsciousness is concerned nor does the result bear any relation to the duration of the narcosis (only once has a suggestion of this been evident; compare the above-cited observation in the case of the man age 55).

The technique used in exerting the pressure is extremely simple, but experience has taught me that the method may fail if it is not applied precisely as it should be; therefore, it may not be superfluous to mention briefly a few details. In the position in which the narcosis nurse generally sits it is perhaps difficult for her to apply a sufficiently powerful downward pressure in the carotid fossa. It is easier to apply pressure in this region if one stands at one side of the patient and turns his head over toward the other side. The pressure is applied either with the thumb or the four fingers together.

There is still a question, however, as to whether compression of the blood vessel is the principal requisite. Can not a similar powerful and painful pressure on other parts of the body, at least during superficial narcosis, produce an *ablenkung* and by reflex action bring about a cessation of the spasms? In order to ascertain if this is so, I have pressed hard, for instance, on the nerves of the axilla and have sought, by other means which affect the centripetal nerves and produce pain, to obtain the same result as by the method described. All such experiments have given absolutely negative results.

It remains only to say a few words as to why my method did not produce the desired result in some cases. The material studied does not throw any light on the subject; unless perhaps it may sometimes be desirable to exert pressure on both sides. As is well known, the carotid arteries vary somewhat in size in different individuals, both in relation to each other and to the basilar artery. This is also the case with the arteria communicantes which enter the circulus arteriosus Willisi. If, therefore, the arrangement of the vessels going to the brain is such that the supply of blood takes place chiefly via the cerebral arteries it can easily be imagined that compression of the carotid fossa in the neck does not exercise any special influence.

In conclusion it may be said that the method has produced no inconvenience nor untoward end-results. If the necessary instructions are given to the person who administers the anæsthetic so that if narcosis tremor appears she will know what to do, there is every probability that this troublesome complication can be avoided and the operation can be completed in peace and quiet.

THE UNRELIABILITY OF TEMPERATURE IN THE OTITIS OF INFANTS AND CHILDREN AS AN INDICATION FOR THE MASTOID OPERATION [1]

By FRED WHITING, M.D., F.A.C.S., New York

AMONG the many vexatious and confusing problems which confront the otologist in his daily experience, few present themselves which offer greater difficulties in their solution than those cases of otitis in young children which, although attended by alarmingly high temperatures, are unaccompanied by convincing physical signs of mastoid inflammation.

It is intended that the scope of this discussion shall be limited in its application to a consideration of inflammatory ear conditions such as manifest themselves in infants and children still too young to participate by their intelligent co-operation in relieving the perplexities of the otologist.

There are so many pathological conditions, some serious, some quite unimportant, which may supervene upon an attack of otitis that any attempt at a comprehensive enumeration of them would prove not only burdensome but unprofitable as well.

Certain of these diseases, however, are encountered as such frequent concomitants of ear inflammations in children that they are entitled to preferential consideration as probable causative agents in the production of temperature whenever a situation arises in which the diagnosis cannot be clearly established.

In considering a few of the diseases which commonly complicate otitic inflammations in infants, we may enumerate bronchopneumonia, lobar pneumonia, especially of the central type, grippe, influenza, gastro-intestinal disturbances, pyelitis, malaria, and the exanthemata.

To this list might be appended a further imposing array of maladies; but those already mentioned are sufficient in number and variety to test the diagnostic acumen of the most experienced physician in the effort to differentiate, in the absence of physical signs, between a group of symptoms which for example may precede a bronchopneumonia and a closely analogous group which is the precursor of meningitis or pyæmia.

So sophisticated have the laity become in recent years in regard to inflammatory ear disease and the serious nature of the complications which emanate therefrom that the relatives and friends of patients not infrequently constitute themselves a board of censors whose insistent demands for an immediate diagnosis are at times sufficiently harrassing to disconcert sorely the attending physician.

Never was the truth of the trite saying, "a little learning is a dangerous thing," more in evidence than at the present moment, the inconsistency of the layman being well illustrated by the following proposition: given a sick baby presenting an array of symptoms including temperature, nausea, vomiting and the like but without inflammation of the ears, and the relatives will contemplate the situation with a reasonable degree of composure if not entire equanimity. Corollary: Given the same baby with the same symptoms, plus suppuration of the ear and the family immediately becomes apprehensive of some dire impending calamity and can with difficulty be induced to take a rational view of the situation; in which attitude they are supported by the manifest concern displayed by an overzealous or timid pediatrist.

What wonder then that the exercise of well-balanced and conservative judgment by the otologist becomes at times nearly if not quite impossible. In view of which experiences there is no occasion for surprise that normal mastoids are sometimes operated upon but rather there is reason for congratulation that such regrettable incidents are not more frequent.

I will briefly enumerate the essential features of but three cases as illustrative of the perplexities which so often confront us.

[1] Presented before the Clinical Congress of American College of Surgeons, October 21, 1919.

Case 1. An infant one and one half years of age the child of a physician. When first seen both eardrums were red and bulging; the child was tossing restlessly about and his temperature was 105°F. A double myringotomy was performed without anæsthesia and a moderate quantity of serosanguinolent fluid evacuated from each tympanum. A culture made from the fluid adhering to the knife blade subsequently developed a pure pneumococcus as the infecting organism. The child's temperature immediately dropped to 100°F. and his restlessness diminished somewhat; but his nurse reported that he had been fretful during the night.

When seen at 3 p.m. on the following day, each tympanic membrane presented an opening amply sufficient for drainage. There was an entire absence of swelling or bulging. The discharge could properly be described as moderate in amount and mucopurulent in character. The temperature was 105°F. and a blood count made at this time showed total white cells 16,000 with 70 per cent polymorphonuclears.

During the four succeeding days of the child's illness there was no material change in the symptoms above enumerated. He did not cough and his respirations, although somewhat accelerated, were not rapid. Nothing resembling a chill was observed and two blood cultures were reported as negative. The ears continued to discharge a moderate quantity of mucopus but physical examination revealed no changes at the fundus which could be regarded as furnishing convincing evidence of any mastoid inflammation. The integument over the mastoid processes was normal in appearance.

The child appeared to be very ill and each afternoon found the inexorable thermometer indicating 105°F. while the morning temperature ranged somewhere about 101°F. presenting a characteristic septic wave.

The patient's father was a physician and when to that statement is added the further illuminating information that he was a pronounced neurasthenic, I am sure that the enviable situation of the attending otologist will appeal with a keen sense of appreciation to some of my hearers who have doubtless enjoyed the felicity of a similar tranquilizing experience..

A glittering galaxy of medical consultants was in daily attendance and every organ of the child's economy including some which were as yet rudimentary, was subjected to the most critical scrutiny with the gratifying result that the anxious parents received a volume of reassuring information as to the number of diseases which the child did not have coupled with the unanimous opinion that the ear condition was the responsible agent in the premises.

I had repeatedly suggested that in view of the nature of the infecting organism, a central pneumonia, the physical signs of which were delayed, might be responsible for the phenomena presented in this case and had maintained with faint hearted support of an otological colleague that the ear symptoms were in no wise convincing of mastoid involvement. So insistent, however, was the attitude of the combined medical advisory board against me that I should have been compelled to operate upon both of the child's mastoids had not a central pneumonia obligingly manifested itself at this juncture and relieved the difficulties of the situation.

The child speedily recovered and the ears became normal within a brief period.

Case 2. An infant one year of age under the care of a colleague who had performed a double myringotomy within a few hours of the febrile onset. The condition of the patient was entirely satisfactory for several days. The amount of discharge moderate and the temperature never above 101°F. Infecting organism: streptococcus hæmolyticus. Ten days after the beginning of the otitis the child suddenly developed a high temperature without any discoverable cause and for one week exhibited wide daily fluctuations between 100° and 105° or even higher.

The usual program was instituted and the child's various functions investigated by skillful consultants who were unable to locate any inflammatory focus other than the otitis and who therefore by process of elimination arrived at the conclusion that they were dealing with a serious complication of ear disease.

Two distinguished otological colleagues who were called in consultation took diametrically opposite views of the situation. One insisted that a double mastoid operation should be performed at once, while the other advised that there should be no operative interference.

Further consultation having been requested I was asked to see the patient and upon examining the ears found a scanty seromucoid discharge escaping from an ample opening in the inferior posterior quadrant of each membrana tympani. There was no bulging or sagging of the meatus nor was there any fullness which would indicate the presence of retained discharges. The picture was such a one as we often see in cases of otitis which are undergoing satisfactory resolution.

The integument over the mastoid area was normal in appearance and pressure in this region elicited no evidence of pain or soreness. I could see no indication for operation other than that of high temperature unsupported by the physical signs of mastoiditis. I advised, therefore, that a blood culture be taken and that the patient be kept under observation pending further developments. This suggestion was adopted and within a few hours the child's temperature became normal and was never again a source of concern.

Four days later the ears were completely healed and the patient discharged from treatment.

Case 3. A girl of 3 years, under the care of a colleague who had performed a myringotomy upon the right drum within a few hours of the febrile onset. For several days the child's condition appeared quite satisfactory, the temperature not rising

above 102°F. and the case was regarded as progressing favorably. The infecting organism was reported to be streptococcus mucosus.

On the fifth day of the inflammation the child had an attack of vomiting with a rapid rise of temperature 104.5°F. The attending otologist was hastily summoned by the parents whose natural solicitude regarding her condition was greatly aggravated by the knowledge that a near relative of theirs had recently died of otitic meningitis.

The examination of the ears failed to disclose any change in the local inflammatory condition which might properly account for the systemic disturbance and castor oil was administered in the belief that a gastro-intestinal attack was responsible for the sudden indisposition.

A blood count taken the same evening provided no information of diagnostic value, showing 12,000 white cells and 72 per cent polymorphonuclears. Notwithstanding effective action of the oil the child's condition remained unchanged. The daily temperature wave recording variations from 101° to 104°F.

The little patient complained of feeling sick (meaning nauseated) but there was no apparent abdominal distention or tenderness. Repeated consultations failed to determine the cause of the temperature or to control the increasing parental anxiety.

I saw the case at the request of the attending otologist and could find nothing in the condition of the ears to warrant mastoid operation. The mother of the child, however, became hysterical over the protracted uncertainty of the case, and the attending surgeon finding his conservative attitude no longer tenable reluctantly consented to operate. He subsequently reported to me in response to my inquiry as to what he had found that he had opened a normal mastoid process.

Forty-eight hours later the cause of the temperature was revealed in a large quantity of pus in the urine, an analysis of which made a few days before had been reported negative.

The child's recovery from pyelitis followed the usual slow course of the disease attended by the discomforts of a needless mastoid operation.

The above enumerated cases are, I am persuaded, in no wise unique, but on the contrary are common to the experience of every busy practitioner.

What attitude then can we reasonably adopt toward such cases which, while safeguarding them from unwarranted and premature operative, measures will not at the same time expose them to the dangers of intracranial inflammation as a consequence of overcautious and dilatory conservatism. Our profession has been accused, and not without reason, of maintaining an unfaltering devotion to medical tradition and of clinging with fanatical loyalty to certain antiquated and discredited standards rather than endeavoring by intelligent investigation to demonstrate the fallacy of such pretensions.

A good illustration of this misapplied fidelity is furnished in a statement which a practitioner made to me the other day, namely that mastoiditis in infants and children is unaccompanied by any recognizable physical signs in the meatus until periosteal swelling can be observed behind the ear. I recall having heard the same statement made when I was a house surgeon. It was no more correct then than now although perhaps more excusable.

Many practitioners who are skillful observers of physical signs in the adult ear are painfully deficient when required to interpret similar appearances in the infant meatus, especially if, as is often the case, the canal is narrow and fairly deep.

To familiarize oneself with the normal structural relations of the infant ear sufficiently to appreciate at their proper valuation the earliest significant inflammatory changes in this organ requires such continuous opportunities for observation as are seldom procurable outside of a children's service in the hospital. And even with the experience derived from such exceptional opportunities the most astute diagnostician may find himself at times baffled by the difficulties presented in examining a very small meatus.

I am convinced that more careful study and observation of the fundus changes in children will enable us to appreciate early signs of mastoid involvement which, with our present superficial diagnostic methods, we frequently overlook.

For example, I have never seen a case of mastoiditis in an infant which did not upon critical inspection show recognizable œdema of the superoposterior segment of the membranous portion of the meatus with some infiltration and bogginess of the structures about the annulus. I think it safe to wait notwithstanding temperatures until such signs appear before operating.

The dangers of delay in operating when demonstrable mastoiditis is present we all appreciate; but is there any justification for

the haste in operating which some colleagues display in their anxiety to anticipate possible serious results?

What untoward consequences may eventuate in a case of acute suppurative otitis in which temperature is the only distinctive factor present if we elect to defer operation until convincing signs of mastoiditis are recognizable.

There is a possibility that serious and sometimes fatal intracranial complications may arise in a small percentage of cases in which no evidence of mastoid inflammation appears at any time, as, for example, primary jugular bulb thrombosis, but such cases are extremely rare and should not be permitted to unbalance our judgment. What anatomical factors are likely to militate against such disastrous consequences? The structural conformation of the infantile type of mastoid is such that the squamomastoid fissure is closed only by fibrous tissue or by an incompletely ossified cementum neither of which tissues offer more than slight resistance to a destructive osteitis; hence the inflammatory products are prone to dissect their way toward the surface, their presence being announced by the altered appearance of the integument over the mastoid process which as a result of periosteitis becomes œdematous, swollen, and red. Is there not as great a likelihood that the osseous structures which interpose a barrier between the antrum cavity and the dura will simultaneously fall a prey to the same destructive osteitis and open an avenue for direct attack upon the meninges and encephalon?

There is unquestionably danger of such a contingency and we not infrequently find destruction of the inner table of the skull with epidural abscess as a concomitant of perforation of the outer table and subperiosteal abscess. None the less the bony structures which lie between the antrum and the dura usually possess a greater density than the more porous and vascular bone tissue which separates the antrum from the periosteum and as a consequence yield less readily to the erosive action of pus. For this reason subperiosteal abscess is a more frequent accompaniment of mastoid inflammation than epidural abscess in my clinic, at the New York Eye and Ear Infirmary in the proportion of 2 to 1.

Is the epidural abscess of infancy commonly associated with a subdural complication; namely sinus thrombosis, cerebral abscess or leptomeningitis? In my experience, no! The outer surface of the dura only is attacked and upon it a protective layer of exudate is disposed accompanied by a further defensive bulwark of granulations, which combined protection constitutes an effectual barrier against subdural infection.

To what extent are these views endorsed by experience drawn from the hospital and clinic? To the extent that large numbers of infants and young children are brought to the clinic suffering from acute otitis accompanied by periosteitis or subperiosteal abscess. These children, so-called neglected cases, have received only such treatment as is comprehended under the term "home remedies" which signifies from the standpoint of the otologist no treatment at all. They represent pure and unadulterated examples of *vis medicatrix naturæ*.

The vast majority of such neglected cases recover after operation, promptly and uneventfully; they have passed without undue excitement or concern through the same gamut of inflammatory manifestations which caused such alarm in the households of the three cases just enumerated and which are merely types of numerous others which we can all of us recall.

Had these neglected clinic cases been under proper medical supervision they would have been operated upon earlier in the course of the disease and hence would not have been exposed to the needless risks of intracranial complications which were present for some days before the swelling in the mastoid region appeared.

What assistance in diagnosis can the laboratory afford in this perplexing class of cases? Only a very limited assistance. The blood count even when frequently repeated for purposes of comparison does not in itself constitute an indication for operation; it supplies at most only corroborative testimony today which tomorrow's finding may invalidate or contradict.

The roentgenogram upon the reading of which we have so justly learned to depend in interpreting structural changes in the adult mastoid bone, cannot be relied upon for positive diagnostic assistance in infants, for the reason that a normal plate of the infantile type of bone is cloudy and inasmuch as little children can with difficulty be kept sufficiently quiet to ensure a proper exposure even when they are anæsthetized. The plates produced are for the most part disappointing and unreliable.

The proposition which I wish to establish is that there is a period preceding the evidences of periosteitis when intelligent and critical scrutiny can detect in the meatus convincing evidence of mastoid inflammation and that this period is the time of election for operating.

I trust that I have made clear my attitude in regard to the conservative position which I think the profession should adopt toward mastoid operations upon children suffering with suppurative otitis whose only manifest symptom of mastoid involvement is temperature.

I certainly do not wish to be understood as advocating that the mastoid operation should be delayed until periosteal swelling is evident behind the ear. I am, however, firm in my conviction that between the period of onset of the otitis and the stage of periosteal swelling, there will appear in the meatus reliable signs of beginning mastoid inflammation which careful scrutiny will reveal, and that the appearance of these physical signs indicates the most favorable time and condition for operation. And furthermore, it is my belief that the welfare of the patient will not be prejudiced by deferring operative procedures until such changes in the meatus manifest themselves.

THE WASSERMANN REACTION AND MISCARRIAGES

By HERMAN GOODMAN, B.S., M.D., New York

IN 1917, through the courtesy of the late Professor E. Cragin, and Dr. R. Ottenberg of the College of Physicians and Surgeons, the opportunity was given us of studying the records of the Sloane Maternity Hospital, with the view of determining the relation between the Wassermann reaction as indicating syphilitic infection, and the number of miscarriages a patient has had.

This study was made from the records of 1,320 women, who had applied to the Sloane Hospital for examination and appointment. It is the policy of the hospital to have blood taken for a Wassermann examination in each instance. The laboratory work is under the direction of Dr. Ottenberg. If any doubt exists as to the character of report, another sample is called for. The history is taken by the examining obstetrician, and includes a statement of the number of interrupted pregnancies the expectant mother has had.

We chose the more conclusive Wassermann negative and four plus positive cases for further analysis. The cases having indeterminate serology were not used because they were too few.

Of the 1,159 Wassermann negative cases, 542 were primiparæ. Of the 637 who had been pregnant previously, 237, or 37 per cent, had suffered a miscarriage. We amplify this in Table II.

TABLE I.—BLOOD WASSERMANN TEST ON 1,320 PREGNANT WOMEN

Result	Number of Cases	Percentage
Negative	1,159	87.
Doubtful	12	0.9
1+	14	1.
2+	17	1.2
3+	29	2.
4+	89	6.7

TABLE II.—NEGATIVE WASSERMANN REACTION

Gravida	Number of Cases	Miscarriages	
		Number	Percentage
II	338	91	27
III	132	51	38
IV	70	31	43
V	35	20	57
VI	20	11	55

The next figures are given to demonstrate another phase of the study.

Of 637 multiparæ with negative Wassermann reactions, 161, or 25 per cent, had had one miscarriage; 41, or 6 per cent, had had two miscarriages; and 22, or 3 per cent, had had had three miscarriages.

Of the 89 Wassermann 4+ positive cases, 30 were primiparæ. Of the 59 who had been pregnant previously, 30, or 52 per cent, had suffered a miscarriage, as compared to 37 per cent for the Wassermann negative cases.

TABLE III.—4+ WASSERMANN REACTION

Gravida	Number of Cases	Miscarriages Number	Miscarriages Percentage
II	26	10	38
III	18	9	50
IV	4	4	100
V	4	2	50
VI	1	1	100

Of 59 multiparæ with 4+ Wassermann reactions, 19, or 21 per cent, had had one miscarriage; 7, or 8 per cent, had had two miscarriages; 4, or 4 per cent, had had three miscarriages.

There were in this series a total of 473 miscarriages among 292 women. This is an average of 1.6 miscarriages per woman. The distribution is interesting.

TABLE IV

Among 247 Wassermann negative women, 391 miscarriages or 1.7
Among 6 Wassermann doubtful women, 15 miscarriages or 2.5
Among 5 Wassermann 1+ women, 5 miscarriages or 1.
Among 6 Wassermann 2+ women, 9 miscarriages or 1.5
Among 8 Wassermann 3+ women, 8 miscarriages or 1
Among 30 Wassermann 4+ women, 45 miscarriages or 1.5

In six cases, the report of anticomplementary was returned, and the request for another sample was complied with. The results follow:

TABLE V

First Wassermann	Second Wassermann
Anticomplementary	Negative
Anticomplementary	Negative
Anticomplementary	Negative
Anticomplementary	4+
Anticomplementary	Anticomplementary
Anticomplementary	Negative

A few other facts appear worthy of some mention. A woman gave a history of having had 16 miscarriages in 19 pregnancies. Her blood Wassermann was repeatedly negative.

Another woman had miscarried ten times previously, and was in her eleventh pregnancy with a negative Wassermann.

No 4+ positive Wassermann patient gave a history of having been pregnant more than six times.

Of the 1,320 cases, only one gave a history of having had syphilis. She was a patient of the Department of Dermatology and Syphilis of the Vanderbilt Clinic, and the treatment under the direction of Professor J. A. Fordyce had rendered her blood Wassermann negative. This patient had been infected by her husband, although he had not had an active manifestation during his wedded life. The woman had never had a clinical symptom. Her Wassermann had been done on the occasion of the discovery of a positive Wassermann in the husband taken because he suffered with chronic headache. Both husband and wife were under antisyphilitic treatment at the time conception took place.

SUMMARY

We found that among 1,320 pregnant women, 87 per cent were Wassermann negative. Only 6.7 per cent gave a 4+ positive reaction, and in 2 per cent more of the cases, the Wassermann was 3+ positive. Of the Wassermann negative multipara, 37 per cent had suffered one or more miscarriages as compared to 52 per cent of the 4+ positive cases.

Only one woman among the 1,320 gave a history of having been known to be infected with syphilis, although approximately one woman out of each 11 gave a strongly positive Wassermann reaction, indicating in all probability, a syphilitic infection. In perhaps every instance, the husband was responsible for the disease in the wife. And yet, there are hospitals throughout the land that refuse to admit men suffering with syphilis. "As they sow, so shall they reap" is the attitude of the hospital board. The diseased wife, and the unborn syphilitic offspring is the result. Every case of syphilis may become the center of an ever-widening circle of infection. Nip the center in the bud! Treat syphilis early! Treat it efficiently! Treat it every time!

THE USE OF POTASSIUM-MERCURIC-IODIDE FOR SKIN DISINFECTION

By WILLIAM FRANCIS McKENNA, M.D., and HENRY ANDREW FISHER, M.D., Brooklyn

MODERN textbooks of surgery, in describing various methods for disinfecting operative sites, give preference to tincture of iodine. The earlier use of wet compresses or packs of bichloride of mercury has been largely abandoned on account of the harmful effect on the epithelial cells. Because of the affinity of this mercury salt for proteins, a direct chemical combination takes place between the cell protoplasm and mercury, resulting in coagulation. This injury to the epidermis lowers the resistance of the tissue, rendering it more susceptible to subsequent infection.

The choice of tincture of iodine apparently is based on clinical experience rather than on any exact experimental data concerning its bactericidal action on the microbial flora of the human skin. This tincture is said to penetrate the follicles more readily than do other germicides, and, while it is supposed to render the skin sterile, there are few references in the literature which fully substantiate this view. On the other hand, the official preparations possess certain drawbacks. Applied to delicate skins irritation is produced, leading to marked dermatitis in some patients. Owing to the tendency of the tincture to spread, the iodine becomes more concentrated at the periphery of the painted area and blistering sometimes takes place. In cases of hyperthyroidism, where a hypersensitiveness to iodine exists, the use of any solution or tincture containing free iodine is contra-indicated. Furthermore, iodine is irritating to such delicate tissues as the peritoneum, and great care must be exercised to guard against any contact between the viscera and the painted edges of the wound in order that subsequent adhesions may be prevented.

Because of the objectionable features of both mercuric chloride and iodine, it was deemed desirable to study the applicability of some other germicide for skin disinfection. For several reasons the double salt of mercury and iodine — potassium-mercuric-iodide — seemed preferable to either of these agents. That it possesses high bactericidal potency has been shown by Macfarlan (1), while Watson (2) reported that in alcoholic solution it was ten times as potent as similar solutions of iodine. It ranks with mercuric chloride in bactericidal efficiency and is superior to it in several other respects. It is readily soluble in water, alcohol and acetone, and in its watery solution does not coagulate albumin. It is far less irritating to the tissues than either mercuric chloride or iodine, and is free from the escharotic action of the latter.

The favorable experience of the authors in the use of this double iodide, both as a general disinfectant and as an antiseptic in the treatment of infections led to the following experiments, designed to test its efficiency in disinfection of the skin.

EXPERIMENT I

The efficacy of any skin disinfectant depends upon its power of penetrating the superficial layers of the skin. The following experiment was planned to give information concerning the extent to which iodine and potassium-mercuric-iodide permeate the sound epithelium. As a control, an acid dye of the phthalic anhydride group—Rose Bengal—was used, because such substances are known to be markedly diffusible in animal tissues.

TECHNIQUE

The skin over the thorax and abdomen of an albino guinea pig was closely shaved, washed with water and then with alcohol. When dry, circular areas about 2 centimeters in diameter were treated as follows:

Area 1. Painted with 7 per cent official tincture of iodine, two minutes later excised and placed in 10 per cent formalin in isotonic salt solution.

Area 2. Same as Area 1, but at the end of two minutes received a second coat of iodine and three minutes later excised.

Area 3. Painted with a 1 per cent solution of potassium-mercuric-iodide in 70 per cent alcohol. Two minutes later painted with 30 per cent ammonium sulphide solution to precipitate the mercury as the sulphide in the tissues. When dry, was excised and fixed.

Area 4. The same as Area 3, but two minutes after first coat it received a second coat of alcoholic potassium-mercuric-iodide, and three minutes later was painted with ammonium sulphide. When dry, was excised and fixed.

Area 5. Painted with a 1 per cent solution potassium-mercuric-iodide in acetone. Procedure same as with Area 3.

Area 6. Painted with a 1 per cent solution potassium-mercuric-iodide in acetone. Procedure same as with Area 4.

Area 7. Painted with a 1 per cent solution of Rose Bengal, two minutes later received a second coat of this solution, then mordanted with 1 per cent tannic acid.

The pieces of skin were embedded in paraffin and cut at 15 μ.

OBSERVATIONS

Areas 4 and 6 show a dense and even deposit of mercury sulphide in the epidermal layer, but no penetration of the true skin. The density of sulphide is greater in 6 than in 4.

Area 7 shows a dense and uniform staining of the epidermal layer but no penetration of the true skin.

Areas 1 and 2 show a slight staining of the epidermal layer.

The results show further that potassium-mercuric-iodide penetrates the skin equally as well as the fluorescein dye, and permeates the epidermis.

EXPERIMENT II

In order to determine the ability of skin to absorb potassium-mercuric-iodide the following experiment was carried out:

TECHNIQUE

Pieces of guinea pig skin, shaved, were placed flat on a smooth sheet of glass, and a glass funnel inverted over the central portion of each. A thick coating of paraffin was then applied over the outside of the funnels and over the skin and glass external to the rims of the funnels. Watery solutions of 1.0, 0.2, 0.1, and 0.01 per cent potassium-mercuric-iodide, respectively, were then poured through the necks of the funnels and allowed to remain in contact with the skin for 24 hours. After this time the unexposed skin was carefully cut from the exposed portions, the skin washed repeatedly in water to remove any excess of potassium-mercuric-iodide and treated as follows: the tissue was digested with sulphuric and nitric acids until a colorless solution was obtained. After cooling, the solution was diluted and made alkaline with ammonium hydroxide. Nitric acid and ferric ammonium sulphate were added and the solution titrated with N/10 potassium sulphocyanide to the production of a permanent yellow color. The amount of potassium sulphocyanide used gave the quantity of mercuric nitrate present and from this the equivalent in potassium-mercuric-iodide was calculated. The findings are shown in Table I.

TABLE I — ABSORPTION OF POTASSIUM-MERCURIC-IODIDE BY THE SKIN

Experiment	Skin area exposed	Strength of potassium-mercuric-iodide solution	Total Hg (Needs found in total skin area	Total Hg Needs calculated as HgI_2	Calculated as K_2HgI_4 per 1 cm² skin	Concentration K_2HgI_4 in skin
	Cm. 2		Gms.	Gms.	Gms.	By weight
I	19 635	1:100	0.2071	0.2809	0.0254	1:4,000
II	31 172	1:300	0.06107	0.0828	0.0040	1:21,000
III	30 19	1:1000	0.02272	0.0308	0.0018	1:55,000
IV	33 18	1:10000	0.00243	0.0034	0.00017	Negligible

TABLE I. — ABSORPTION OF POTASSIUM MERCURIC-IODIDE BY THE SKIN

These experiments would seem to show that guinea-pig skin absorbs appreciable amounts of potassium-mercuric-iodide, and that the absorption varies directly in proportion to the solution concentration of the salt. By calculating the actual amount of double iodide present in one square centimeter of skin it would appear that the application of a 1:100 solution produces an actual concentration of the salt in any given skin area equal to 1:4000. Since the potassium-mercuric-iodide is in watery solution and is applied to tissues having a normal water content, dissociation of the salt takes place, and it is reasonable to assume that it exerts a germicidal action comparable to the germicidal action *in vitro* of a similar solution. That this assumption is not unwarranted is attested by the experiments described below.

EXPERIMENT III

The object of the following experiments was to study the disinfecting power of solutions of potassium-mercuric-iodide when applied to the skin. The method adopted was planned to conform with the best procedure employed in applying iodine tinctures and solutions preparatory to surgical operations. Two modifications were introduced for the purpose of making the conditions of the experiment more exacting than the conditions obtaining in the usual surgical practice.

TABLE II

Experiment III	Guinea Pigs No. 1 and No. 2					
		Time	Incubation			
Solution	Strength	of Exposure	24 Hours	48 Hours	72 Hours	Remarks
Potassium-mercuric-iodide in 70 per cent alcohol	1:100	2 minutes	O	O	X	Staphylococcus at 72 hours
	1:100	5 minutes	O	O	O	Remains sterile
Tincture of iodine U. S. P.	7 per cent	2 minutes	O	X	X	Sporulating bacillus, no staphylococcus
Tincture of iodine U. S. P.	7 per cent	5 minutes	O	X	X	Sporulating bacillus, no staphylococcus
Control A. Alcohol	70 per cent	5 minutes	X	X	X	Sporulating bacillus and staphylococcus
Control B. Untreated	.....	.....	X	X	X	Sporulating bacillus and staphylococcus

TABLE III

Experiment IV	Guinea Pigs No. 3 and No. 4				
		Time of	Incubation		
Solution	Strength	Exposure	24 Hours	48 Hours	Remarks
Potassium-mercuric-iodide in acetone	1:500	2 minutes	O	X	Staphylococcus
	1:500	5 minutes	O	X	Staphylococcus
Potassium-mercuric-iodide in acetone	1:250	2 minutes	O	X	Staphylococcus
	1:250	5 minutes	O	X	Staphylococcus
Potassium-mercuric-iodide in acetone	1:100	2 minutes	O	O	Sterile
	1:100	5 minutes	O	O	Sterile
Control A. Acetone	100 per cent	5 minutes	X	X	Staphylococcus
Control B. Untreated	.....	.....	X	X	Staphylococcus

Washing the shaved skin with soap or alcohol preparatory to applying the disinfecting solution was omitted in order not to disturb or diminish the normal bacterial flora of the skin. Furthermore, after the desired exposure to the action of the germicide, the skin was thoroughly washed in sterile saline for the purpose of removing any of the germicide remaining free on the surface of the skin, which might be carried over into the culture medium and exert an inhibiting action on any organisms present.

TECHNIQUE

The skin over the abdomen of an etherized guinea pig was closely shaved, the soap removed with water and the skin allowed to dry. Several hours later separate areas of about 2 centimeters square were then painted with (a) a 1:100 solution of potassium-mercuric-iodide in 70 per cent alcohol and (b) 7 per cent tincture of iodine. At the end of two minutes a square of skin (about 1 centimeter square) was excised under aseptic precautions, washed for five minutes through two solutions of sterile saline, and then dropped into tubes containing 30 cubic centimeters of 1 per cent dextrose broth (reaction×1.0). Other squares were given a second painting three minutes after the first application, excised two minutes later, or five minutes after the first application, then washed, and planted in broth as above. A similar square was painted with 70 per cent alcohol, then excised after the desired interval, washed in saline as above and planted in broth. Incubation was at 37.5°. All tests were repeated at least twice.

Table II shows that a 1 per cent solution of potassium-mercuric-iodide is fully equal, if not superior to 7 per cent tincture of iodine in its sterilizing action on human skin. The comparison is in favor of the former, because the concentration of the salt is only one-seventh that of the tincture. The fact that the skin treated with one application of either double iodide or iodine tincture and excised two minutes after exposure yielded no growth in broth after 24 hours' incubation would seem to show that the micro-organisms situated at or near the surface of the skin were killed. It is likely that the appearance of growth after longer incubation is due to a few surviving organisms which in their deeper, and, therefore, more inaccessible position in the tissue escaped the action of the germicide, and were only released after a softening and permeation of the skin by the culture medium.

EXPERIMENT IV

Since rapid drying of the disinfecting solution is an advantage, the double iodide dissolved in acetone was employed in this experiment. This hydrocarbon possesses the advantage of having a solvent action on the natural fats of the skin, and of rapidly evaporating. It was felt that such a medium would favor penetration of the double salt. (Table III.)

This experiment confirms the results of

TABLE IV

Experiment V — Guinea Pigs No. 5 and No. 6

Solution	Strength	Time of Exposure	Incubation 24 Hours	Incubation 48 Hours	Remarks	Incubation 24 Hours	Subcultures 0.2 ccm. of 48 Hour Cultures in 30–40 ccm. fresh broth Remarks
Potassium-mercuric-iodide in 70 per cent alcohol....	1:100	2 minutes	0	X	Spore-bearing bacillus and staphylococcus	X	Spore-bearing bacillus and staphylococcus
		5 minutes	0	X		X	
Potassium-mercuric-iodide in 70 per cent alcohol....	1:200	2 minutes	0	X	Spore-bearing bacillus and staphylococcus	X	Spore-bearing bacillus and staphylococcus
		5 minutes	0	X		X	
Potassium-mercuric-iodide in 70 per cent alcohol	1:100	2 minutes	0	X	Same bacillus but no staphylococcus	X	Spore-bearing bacillus but no staphylococcus
		5 minutes	0	X		X	
Tincture of iodine U. S. P....	7 per cent	2 minutes	0	X	Same bacillus but no staphylococcus	X	Spore-bearing bacillus but no staphylococcus
Control A. Alcohol.....	70 per cent	5 minutes	X	X	Same bacillus and staphylococcus	X	Spore-bearing bacillus and staphylococcus
Control B. Untreated	.....	.....	X	X	Same bacillus and staphylococcus	X	Spore-bearing bacillus and staphylococcus

Experiment II and shows further that acetone is a desirable solvent for potassium-mercuric-iodide when used for skin disinfection.

The question arose whether the failure of the treated skin to show any bacterial growth in the culture medium was due to a possible inhibitory effect of the double iodide absorbed by the skin and liberated in the broth, or whether the lack of growth was in reality due to a killing of the bacteria. To determine this question the following experiment was done:

EXPERIMENT V

The technique was precisely the same as in the foregoing experiments. At the end of three days' incubation, 0.2 cubic centimeters of the broth containing the treated skin was transferred to tubes containing 30 to 40 cubic centimeters of freshly sterilized broth. This volume gave sufficient dilution to overcome any possible inhibiting action on the part of the potassium-mercuric-iodide given up by the skin to the broth culture. (Table IV.)

DISCUSSION

The experiments detailed above disclose the fact, formerly known but not always appreciated, that the application of germicidal solutions to the skin kills bacteria on the surface and many of the organism in the skin follicles, but does not effect absolute sterilization of the skin.

The location of micro-organisms in the hair or sebaceous follicles and in sweat ducts; the presence of fats in these follicles, preventing contact between the bacteria and the bactericide; and the fact that no chemical may be used in a concentration so great as to injure the tissue cells, are factors which militate against absolute sterilization of the skin. The results obtained, however, show conclusively that solutions of potassium-mercuric-iodide or tincture of iodine in dilutions free from any harmful action, are efficacious in killing bacteria on and in the skin, and therefore must be considered as having a definite value in lessening the possibilities of bacterial infection in surgical operations as well as in the treatment of traumatic wounds. These experiments also show that potassium-mercuric-iodide in a concentration of 1:100 in acetone or in 70 per cent alcoholic solution is more efficient for this purpose than is the official tincture of iodine. The greater penetration of the potassium-mercuric-iodide in acetone as shown in Experiment I, and the more rapid evaporation of this solvent make this solution the most desirable one for use. Furthermore, solutions of this double iodide do not stain, and produce no irritation or blistering of the skin. In these respects, therefore, potassium-mercuric-iodide in a strength of 1 per cent in 70 per cent alcohol—or better, in acetone—is preferable to iodine for the disinfection of the skin.

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A STUDY OF THE ARTERIES SUPPLYING THE STOMACH AND DUODENUM AND THEIR RELATION TO ULCER

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THIS work was undertaken to determine, if possible, whether there is any difference in the character of the arteries in the stomach and duodenum, in the regions in which ulcers are prone to occur. At the operating table practically all ulcers of the stomach are found along the lesser curvature, and 98 per cent of the duodenal ulcers are found within one and one-half inches of the pylorus; the greater number on the anterior wall within the first inch. It would seem that there must be a special factor to cause this curiously selective character.

The two portions of the bowel, the stomach, and the first one and one-half inches of the duodenum, should be considered as modified portions of the same region of the primitive alimentary tube. From an embryologic standpoint the beginning of the duodenum resembles the stomach in that it arises from the foregut. The first inch is freely movable; it is covered in front and behind by the same two layers of peritoneum that cover the stomach. The mucous surface of the first one and one-half inches of the duodenum is devoid of folds (valvaluæ conniventes), and the villi are short. The distribution of blood vessels supplying the stomach and the first one and one-half inches of the duodenum is not regular as it is in the rest of the bowel.

TECHNIQUE

Sixty-two human stomachs and duodenums procured at necropsies from 1 to 4 hours after death have been investigated. Most of the specimens were injected before being removed from the body. For injecting the arteries, slightly acid gelatin-carmin solution gave the best results. Ten per cent gelatin solution was filtered through several thicknesses of cheese cloth. Sufficient carmin to make 1.5 per cent solution was ground in a mortar and partially dissolved in a small amount of water containing a few drops of acetic acid; this was added to the warm gelatin solution and thoroughly stirred. A few crystals of thymol were added as a preservative. When ready for use, the gelatin-carmin was melted over a water bath and injected at a temperature between 45°C. and 50°C. To inject the capillaries the carmin should first be dissolved in ammonium hydroxide to eliminate the granules, then neutralized with acetic acid (Bayne-Jones). If the gelatin-carmin solution is alkaline, the dye will diffuse through the tissue and obscure smaller vessels.

All of my injections were made through the cœliac axis, the hepatic artery being ligated at the porta hepatis, and the inferior pancreaticoduodenal at its origin from the superior mesenteric. In some of the cases the splenic artery was clamped off at the hilus of the spleen.

Several injections were made to include the capillaries, but no attempt was made to inject the veins, although they were partially filled in a few instances. As a rule the best injections were in stomachs that were moderately distended either with air or fluid. Specimens distended with air soon after injection were useful when hardened and dried. Fixation of specimens in 10 per cent formalin solution for 12 to 24 hours immediately after injection proved the most instructive method, as it was then comparatively easy to make a complete dissection of the vessels of the submucosa by means of a dissecting microscope. For microscopic study, blocks of tissue were cut from various parts of the stomach and duodenum and fixed in 10 per cent formalin. Serial frozen sections from 50 to 100 microns were cut, stained with hæmatoxylin, and mounted in balsam.

A few specimens were injected with 10 per cent gelatin to which was added bismuth or barium sulphate. One specimen was injected with 15 per cent thorium and one with 25 per cent sodium bromide. Each of these

specimens was distended with air and stereoscopic roentgenograms taken. The ones containing barium or bismuth made the best roentgenograms (Fig. 1), but since they showed only the larger vessels in the submucosa, they were of little value in this study.

THE GASTRIC ARTERIAL SYSTEM

It may be well to describe briefly the larger vessels supplying the stomach and the duodenum, although my chief interest in this study was in the smaller vessels of the mucosa and submucosa of those areas of the stomach and duodenum in which ulcer is most often found.

THE CŒLIAC AXIS

The cœliac axis (arteria cœliaca) is given off from the anterior surface of the aorta between the crura of the diaphragm, a short distance below the aortic opening. It is a short, thick trunk, extends forward and slightly downward above the upper margin of the pancreas for about one-half inch, and then breaks up simultaneously just behind the posterior layer of the lesser sac of peritoneum into the gastric, hepatic, and splenic arteries.

THE GASTRIC ARTERY

The gastric artery (arteria gastrica sinistra) runs upward and to the left, crosses the left crus of the diaphragm behind the peritoneum and gains the lesser curvature of the stomach near the cardiac end by arching forward between the two layers of peritoneum which are reflected from the stomach and œsophagus on to the diaphragm. On reaching the stomach the artery gives off an œsophageal branch which soon divides into several smaller ones to supply the terminal œsophagus and a limited area of the stomach around the cardia. Just after giving of the œsophageal branches, the artery curves downward and to the right along the lesser curvature between the two layers of the gastrohepatic omentum. It soon divides into two branches, both having their path along the lesser curvature, one anterior and one posterior. In their course, these branches give off from three to five branches to the surface of the stomach next to which they travel, as well as some very small branches to the lesser curvature and to the gastrohepatic omentum. The two main branches may terminate in several different ways. Both may anastomose with the two terminal branches of the pyloric artery (arteria gastrica dextra) which in such a case is bifurcated, or only one, more frequently the posterior branch, will anastomose with the non-bifurcated pyloric artery (Figs. 2 and 3). In other cases there is no end-to-end anastomosis with the pyloric on the surface of the stomach; each branch is lost by the perforation of its secondary divisions into the muscular coats of the stomach; the anastomosis then takes place in the submucosa. Because of the absence of the pyloric artery in a very few instances no sort of anastomosis can be found. Leriche and Villemin found no anastomosis in 6 of 55 cases. In a single case of my series of 62 cases, no anastomosis could be found; this was due to the absence of the pyloric artery. From the arcade along the lesser curvature there are from 3 to 5 branches which run downward on both the anterior and posterior walls for a variable distance to penetrate the muscular coats. A second group of very small arteries enters directly through the muscular coats on the lesser curvature.

THE HEPATIC ARTERY

The hepatic artery runs slightly forward and to the right over the right crus of the diaphragm and along the upper border of the head of the pancreas behind the posterior layer of the lesser sac of peritoneum. It bends forward, crosses the left surface of the portal vein, and enters between the two layers of the gastrohepatic omentum at the upper margin of the duodenum. It then courses upward and to the right to the porta hepatis of the liver lying in the free margin of the gastrohepatic omentum in front of the portal vein and to the left side of the common bile duct. On entering between the two layers of the gastrohepatic omentum, the hepatic artery gives off the pyloric artery (arteria gastrica dextra). This vessel descends between the two layers of peritoneum to the pylorus, giving off branches both to the anterior and posterior surfaces, which usually anastomose with the duodenal vessels in the

submucosa. The artery terminates on the lesser curvature of the stomach as described. The gastroduodenal artery is given off from the hepatic soon after the pyloric. It varies from one-half to one inch in length and descends behind the first part of the duodenum about three-fourths of an inch to the right of the pylorus, where it terminates by dividing into the superior pancreaticoduodenal and the right gastro-epiploic. The right gastro-epiploic usually gives off one or two very small branches to the lower margins of the first part of the duodenum, then enters between the two layers of the gastrocolic omentum to run along the greater curvature of the stomach and anastomoses with the left gastro-epiploic from the splenic. From this arch branches are given off at much more frequent intervals than on the lesser curvature. Although arteries from the lesser curvature are fewer in number, they run a longer course (Figs. 2 and 3). The branches from both arches run in the serous coat for a short distance, then perforate the muscular layers to form a very extensive series of anastomoses in the submucosa.

THE SPLENIC ARTERY

The splenic artery (arteria lienalis) runs a rather tortuous course more or less horizontally to the left over the left crus of the diaphragm, left suprarenal and upper pole of the left kidney, and just above the upper margin of the pancreas behind the posterior wall of the lesser sac of peritoneum. On leaving the region of the kidney it enters between the two layers of the lienorenal ligament and breaks up into several branches which enter the hilus of the spleen and at the same time give off the right gastro-epiploic and several short gastric branches. These vessels enter between the two layers of the gastrolienal ligament and pass onto the greater curvature of the stomach. The left gastro-epiploic runs to the right and by anastomosing with the right gastro-epiploic it forms the arcade of the greater curvature. The short gastric branches are distributed to the left end of the greater curvature where they help to supply the fundus, and they pass to both anterior and posterior surfaces and anastomose in the submucosa with the cardiac branches of the left gastric and left gastro-epiploic arteries.

ARTERIES OF THE GASTRIC SUBMUCOSA AND MUCOSA

On examining the plexus or series of anastomoses made by the arteries in the submucosa, it is found that there is quite a marked difference between those of the lesser curvature and those of the rest of the stomach. Compare Figures 4 and 5.

All the arterial branches destined to supply the stomach penetrate the muscle coats and enter the submucosa where they form a very extensive plexus, or network of comparatively large vessels. Those from both curvatures anastomose freely with each other and reach across to anastomose with those of the opposite curvature (Fig. 4). The plexus is remarkable in that all the vessels run a very tortuous wavy course and give off branches which are to a great extent of equal size throughout the entire stomach except along the lesser curvature. Since the submucous plexus on the lesser curvature is different from that in other parts of the stomach, I shall describe it separately. It is made up by small perforating branches from the main trunks along the lesser curvature. On entering the submucosa these vessels bifurcate and run more or less parallel with each other between the œsophageal opening and the pylorus. They are much smaller, make fewer anastomoses and run more than twice the distance of the same-sized vessel in any other part of the stomach (Fig. 5). By means of rather small branches this plexus anastomoses with those on the anterior and posterior walls. The two plexus have the same relative position in the wall of the stomach, that is, midway between the inner muscle coat and the muscularis mucosa. In an injected specimen it is quite easy to dissect away either or both the mucous and muscular coats.

From the plexus of arteries in the submucosa, two systems of branches are given off; one passes to the muscular coats and the other to the mucous coat. I shall not describe the former. In many respects my findings agree with the investigations of Disse, published in 1904. The system of vessels going to the mucosa is somewhat complicated. The ves-

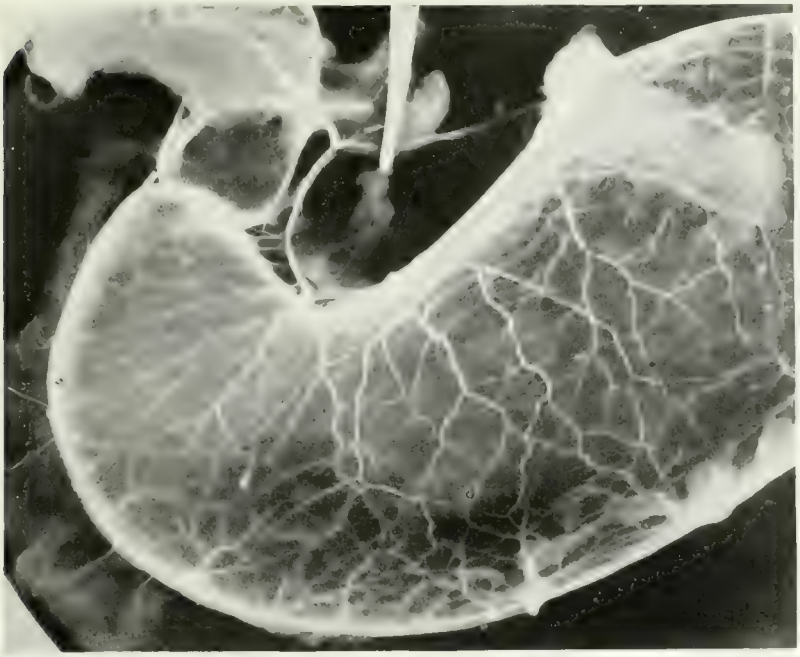

Fig. 1. Stereoscopic roentgenogram. Vessels injected with gelatin-bismuth solution.

sels run in a slanting direction toward the muscularis mucosa and at the same time take a very tortuous course. They usually divide twice before reaching the musuclaris, the branches having the same spiral-like course, often twisting about each other and in this manner passing through the muscularis mucosa. As they enter into the mucosa they suddenly become smaller by giving off branches that are terminal arteries, connected only by means of a capillary network (Figs. 6 and 7). These vessels continue to run a rather winding course and it seems that the transition from arterioles into capillaries may take place anywhere in the mucosa, but for the most part the change is in the deeper half. According to Disse (3) each end-artery supplies an area of mucosa about 2.5 millimeters in diameter. From the character and arrangement of the arteries in the submucosa, it would seem that they are well adapted for the regulation of the blood supply to the mucosa.

ARTERIES OF THE DUODENUM

The duodenum, except for its first one and one-half inches, receives its blood supply entirely from the superior and inferior pancreaticoduodenal arteries. The superior is one of the terminal branches of the gastroduodenal, and arises behind the duodenum about three-fourths of an inch to the right of the pylorus. It inclines to the right and soon divides into an anterior and posterior branch. These, however, may come off separately from the gastroduodenal (Fig. 8). The two branches run downward between the duodenum and the head of the pancreas; they are both overlapped by the thin margin of the pancreas projecting in front of and behind the margin of the duodenum. The posterior of these branches runs in intimate relation with the lower portion of the common bile-duct (Figs. 3 and 8). The inferior pancreaticoduodenal is given off from the superior mesenteric just before the latter passes in front of the third part of the duodenum. It runs to the right behind the superior mesenteric vein and soon divides into anterior and posterior branches which run along between the duodenum and the pancreas to anastomose with the two branches of the superior pancreaticoduodenal, thus making two arcades

Fig. 2. Dissection, illustrating the blood supply of the stomach and duodenum. Note the number of vessels along the greater curvature in comparison with the lesser.

in the curvature of the duodenum, as shown in Figures 3 and 8. From these two arcades, branches pass quite regularly to the anterior and posterior walls of the duodenum and tend to encircle the bowel. After reaching the bowel they soon pierce the muscular coats and form a submucous plexus by a series of anastomosing arcades (Fig. 9). This plexus is made up of a series of branches given off from the larger arteries encircling the bowel. These branches anastomose with each other; they are short and relatively of the same length and caliber. The encircling vessels become gradually smaller until finally they are the same size as the anastomosing branches. Under these conditions it seems that the blood pressure must be the same in all branches entering the mucosa, thus insuring a constant blood supply to all parts of the mucosa. From the submucous plexus, vessels are given off to supply the muscular coats; these vessels will not be described here. The greater part of the blood stream is carried to the mucosa through two sets of arteries; one to the villi, and one to the lower ends of the crypts. On piercing the muscularis the arteries give off a variable number of branches to the villi; there being usually one to each villus. This artery passes almost through the center and terminates in capillaries near the summit (Fig. 10). The crypt type of artery, on entering the mucosa, divides into several branches which radiate in all directions, and run along the bases of the glands (Mall, 9). These in turn give off branches which pass upward around the glands and soon terminate in capillaries which supply the glands and stroma (Fig. 10).

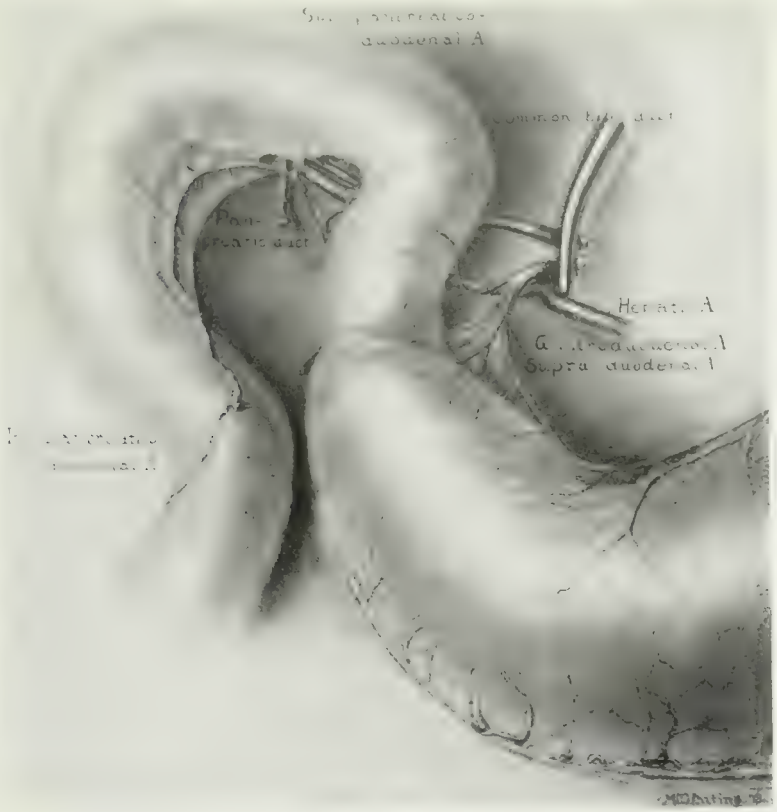

Fig. 3. Dissection showing the blood vessels and their relations to the pyloric end of the stomach and the duodenum. Anterior view. Pancreas dissected away.

The first one and one-half inches of the duodenum receives its blood supply chiefly from an artery which is usually given off from the gastroduodenal or hepatic. This vessel has been described at length by Wilkie under the name of "supraduodenal artery." From its origin, as shown in Figures 2, 3, and 11, it runs downward between the two layers of the lesser omentum to the upper margin of the duodenum. Here it gives off a small branch to the posterior surface of the duodenum while the main vessel comes on the anterior surface to anastomose rather sparingly with a small branch of the pyloric, a small branch of the right gastro-epiploic, and with branches of the superior pancreaticoduodenal (Fig. 11). The posterior wall of the first one and one-half inches of the duodenum is supplied chiefly by small branches from the gastroduodenal artery, given off as that vessel passes behind the bowel. It also receives some small twigs from the supraduodenal, pyloric, and right gastro-epiploic arteries. These arteries, soon after reaching the wall of the duodenum, penetrate the muscular coat and form a submucous plexus which is strikingly different from that lower down in the bowel. Compare the first and second halves of Figure 11. The first inch certainly has very few arteries in the submucosa in comparison with other parts of the duodenum. It would seem that this explains the observation of W. J. Mayo regarding the "anæmic spot" produced by traction, usually seen on the surface of the bowel in this region. From the submucous plexus of vessels, branches are given off to the mucosa which simulate to a marked degree the vessels of the stomach. They are not quite so large nor do they run so consistently

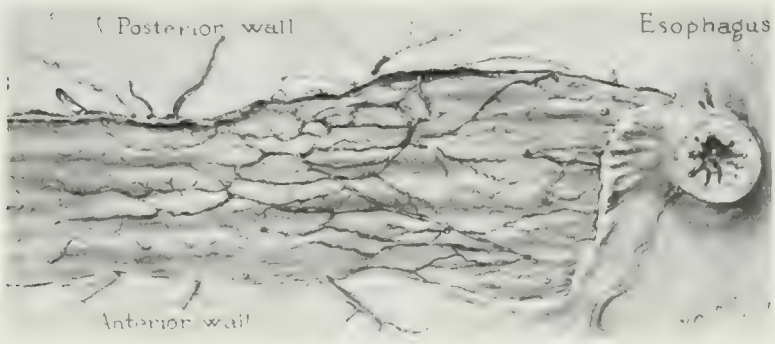

Fig. 5. Dissection illustrating the submucous plexus of arteries on lesser curvature of stomach. Note their length, size, and general direction.

tortuous a course. Yet many are definitely of the spiral gastric type; this is particularly noticeable just as they enter the muscularis mucosa (Figs. 12 and 13). Beside the gastric type of crypt vessels in the first inch of the duodenum is the villus type; and since the villi are not so numerous nor so high as they are farther down in the bowel, these arteries are correspondingly modified (Fig. 14). There are possibly a few more arteries in the submucous plexus on the posterior than on the anterior wall of this portion of the duodenum; otherwise the blood vessels are similar.

The transition from stomach to duodenum is not sharply marked either in the mucosa or in the submucosa. Brunner's glands are often found in the pylorus and the pyloric glands frequently extend over into the duodenum (Bailey). In fact, Brunner's glands are believed by Oppel and others to be a continuation of the pyloric glands. Certainly the gastric type of artery is carried over into the duodenum, the change being gradual.

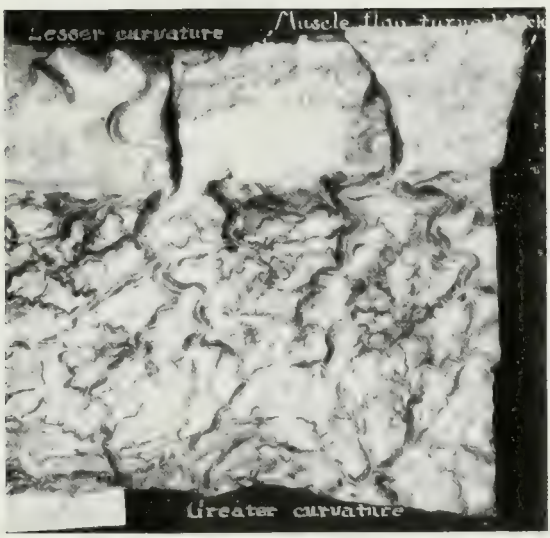

Fig. 4. Arteries of the submucosa of the posterior wall of the stomach. Note the winding tortuous course of the smallest branches. Dissection photograph.

Fig. 6. Arteries of the stomach mucosa with a few capillaries injected. Photomicrograph (x 50).

According to Mall (8) the crypt vessels of the small intestine become submucous vessels in the stomach and the arteries to the villi become smaller and are the stellate vessels of the mucosa in the stomach.

THE SIGNIFICANCE OF GASTRIC AND DUODENAL ARTERIES IN RELATION TO ULCER

The character of the arteries of the submucosa and of the mucosa of the stomach from a normal as well as from a pathologic standpoint has a physiologic significance. The glands secrete chiefly during digestion when the walls of the stomach are expanded; during this period they need a rich blood supply. From a physiologic standpoint it is of advantage to the organism if the flow of blood to the capillaries of the mucosa is made less difficult when the stomach is filled, and that the blood supply is limited when the stomach is empty. With a full stomach, when the walls are expanded, all of the rugæ or folds of the mucosa disappear except two along the lesser curvature; all the winding spiral curves and marked tortuosities of the arteries are straightened out, except those along the lesser curvature; thus the resistance offered the blood stream by the very tortuous arteries decreases and the flow of blood to the mucosa is made less difficult (Waldeyer). Of course, there is undoubtedly a nervous influence at work at the same time, causing a dilatation of the vessels. But the latter influence is entirely separate and distinct from the mechanical resistance offered by the vessels. As the stomach empties itself and becomes gradually smaller following digestion, the arteries of the mucosa and submucosa become more tortuous and the blood meets with greater resistance. Thus the blood content of the mucosa is not nearly so great in an empty as in a full stomach.

Among the most generally accepted theories advanced regarding the etiology of gastric and duodenal ulcer is the theory that they are caused by a hæmatogenous infection. The clinician and the surgeon in their attempts to establish a cure for ulcer are realizing more and more that they are dealing with an infectious process.

Pathological changes in the vessels result in

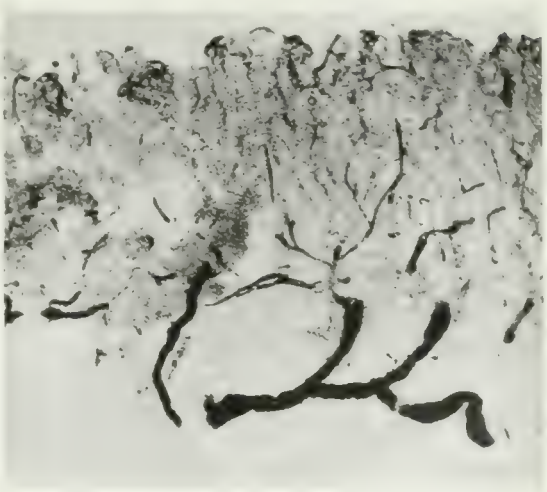

Fig. 7. Vessels entering the gastric mucosa. Note the sudden diminution in size of the vessels. Many branches are not injected because of plugging with carmin granules. Photomicrograph (x 50).

marked changes in the blood flow, due not only to the partial obstruction, but also to the diminished elasticity and contractility of the arterial walls. Virchow was among the first to call attention to the fact that thrombosis or other vascular lesions producing obstruction of the vessels in the gastric mucosa results in hæmorrhagic necrosis which, in the presence of the gastric juice, leads to ulcer. A local endarteritis producing practically an obstruction of a vessel, which makes few or no anastomoses and supplies a relatively large area of the mucosa, probably causes a chronic gastric ulcer in rare instances in elderly persons, just as superficial ulcers and even gangrene are produced elsewhere by the same cause. This type of ulcer will not heal, probably because of the lack in power of the diseased vessels to regenerate new ones to supply the affected area with arterial blood. Various observers in their attempts to produce gastric and duodenal ulcer by disturbing the circulation have shown that embolism of the vessels entering through the muscularis mucosa gives the most pronounced results. The collateral circulation of the vessels in the submucosa is so great that one of the four large vessels passing on to the wall of the stomach may be ligated without causing harm to the stomach (Baumann.) The collateral circu-

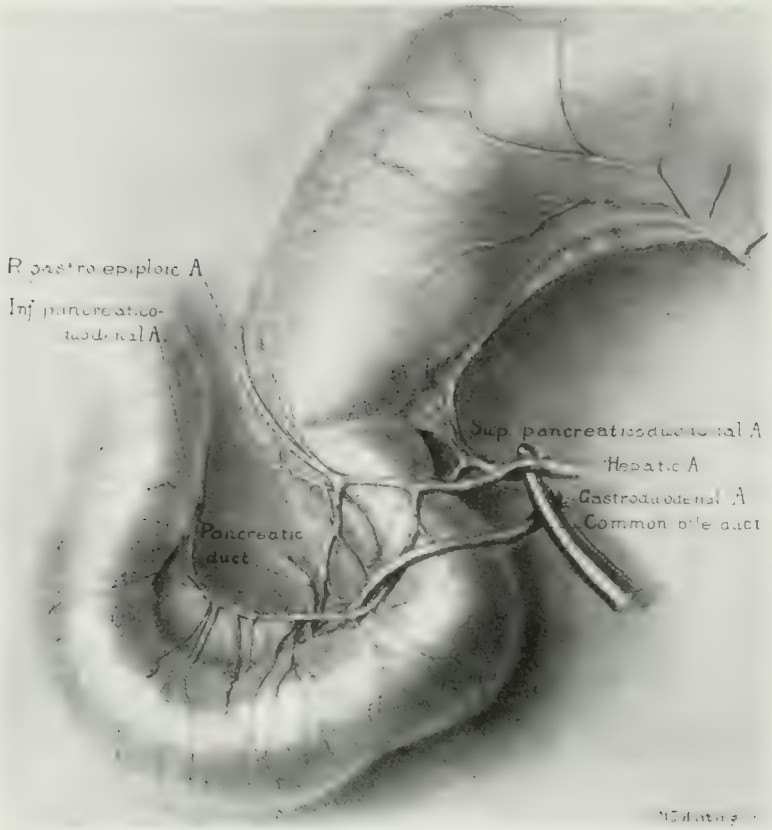

Fig. 8. Dissection drawing showing the blood vessels and their relations to the pyloric end of the stomach and the duodenum. Posterior view. Pancreas dissected away.

lation in the mucosa, however, is limited, for the most part, to capillaries.

Cohnheim, in 1890, produced acute ulcers by the injection of foreign substances into the gastric circulation. In these cases the injecting material seemed to occlude the vessels entering the muscularis mucosa and to cut off the circulation to a limited area of the mucosa. The action of the gastric juice on the dead or devitalized tissue probably contributed to the production of acute ulcers. This type of ulcer heals readily since there is nothing to cause additional destruction of tissue, and since the natural tendency of the body is to repair the damage done.

Rosenow injected streptococci isolated from gastric and duodenal ulcers in man into the venous circulation of experimental animals and produced gastric and duodenal ulcer in 60 per cent, and a total of ulcer and hæmorrhage in 83 per cent of the animals injected. I quote from his summary: "The ulcers produced by the injection of streptococci resemble those in man in location, in gross and microscopic appearance, and in that they tend to become chronic, to perforate, and to cause severe or fatal hæmorrhage." According to Rosenow's description, "both the circumscribed hæmorrhage and the ulcer are cone-shaped with the base of the cone at the surface and the apex at the muscularis." From the anatomic arrangement of the vessels in the mucosa, this circumscribed area of hæmorrhage is just what one would expect from thrombosis or disturbance of the circulation of the vessels entering through the muscularis mucosa. Since this type of ulcer is produced by strepto-

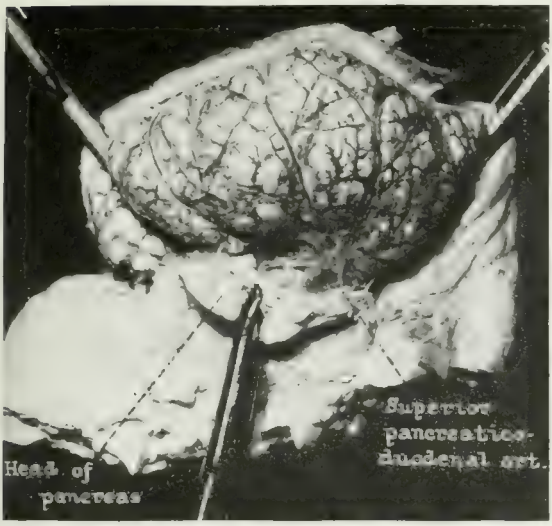

Fig. 9. Anterior wall of the second part of the duodenum; muscular flap dissected away. Photograph of specimen.

cocci, it tends to become chronic and to have all the characteristics of ulcer in man; the streptococci serve as a constant irritant and prevent healing. The continued action of the localized infection in the deep layers produces local circulatory disturbance, hæmorrhage, anæmia, etc. Since the gastric juice digests devitalized tissue, and since the vascularization of the underlying tissue may become gradually less, perforation may be the final outcome.

As has been stated, the rugæ of the stomach mucosa disappear with expansion of the walls. There are two folds, however, one anterior and one posterior, along the lesser curvature extending from the œsophageal orifice toward the pylorus which do not disappear (Waldeyer). Lewis has shown these folds on his reconstruction models of the stomach in the human fœtus. He has described a canal along the lesser curvature which he named "canalis gastricus." Waldeyer in his review of this subject states that these folds become larger with the filling of the stomach and finally form a canal running lengthwise of the lesser curvature. When a stomach is distended with air or fluid even to the point of rupture, the lesser curvature takes comparatively little part in the distention and the

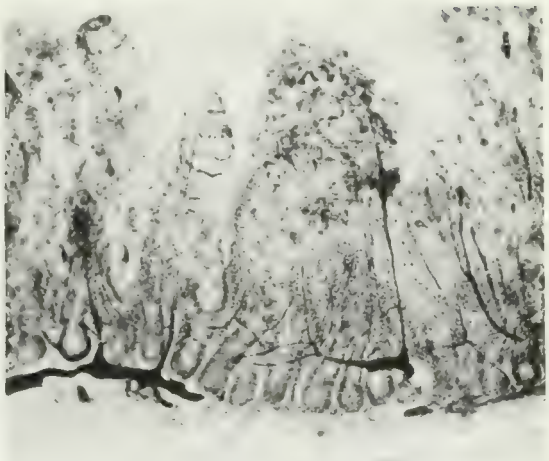

Fig. 10. Villus and crypt type of arteries in duodenum Capillaries injected. Photomicrograph (x 50).

break always occurs at the fundus. I have noticed particularly that it is more difficult to get a good injection of the vessels in the mucosa of the lesser curvature than elsewhere, even with distention of the stomach. This is also true of the first inch of the duodenum. Mall (9), in his work on the stomachs of dogs, reports similar difficulties in injecting the vessels of the pylorus and of the beginning of the duodenum.

The vessels of the mucosa on the lesser curvature are not essentially different from those in the rest of the gastric mucosa. But the arteries making up the submucous plexus

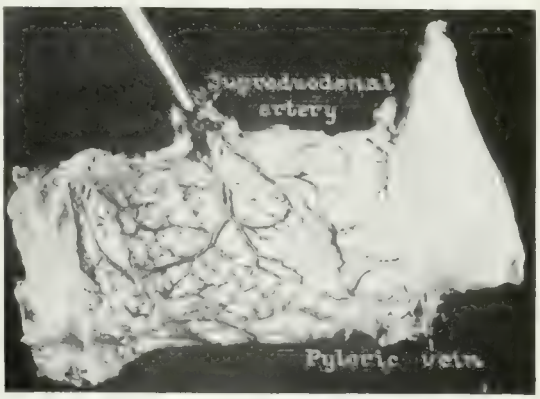

Fig. 11. Dissection photograph showing submucous plexus of arteries. First part of duodenum. Note how few vessels are in the first inch.

Fig. 12. Gastric type of spiral artery in the duodenum. Branches plugged with carmin granules, hence no other vessels in the field. This is in itself suggestive of a terminal artery. Photomicrograph (x 100).

are very much smaller and make longer anastomoses than those in the rest of the submucosa. Due to the permanent folds, the vessels along the lesser curvature do not have so great an opportunity to straighten out with moderate distention as those in other parts of the stomach. Thus the resistance offered the blood stream by the much smaller and constantly winding tortuous arteries is never removed. As a result the blood current entering the mucosa is constantly slower and at a lower pressure than in any other region of the stomach. Hence it seems the arteries are more liable to thrombosis.

As I have stated the arteries making up the submucous plexus in the first inch of the duodenum are comparatively few in number. They are rather small and do not anastomose freely. From this plexus we find along with others the gastric type of spiral tortuous artery entering the mucosa. The mucous lining is practically devoid of folds; distention, therefore, has little effect toward the straightening out of these vessels. The rather limited blood supply in itself to this area of the duodenum probably causes a slower blood current. Further, the presence of the gastric type of artery offers a remarkable resistance to the blood stream. Due to these conditions it seems that the arteries of the first inch of the duodenum are more liable to thrombosis than those of any other region.

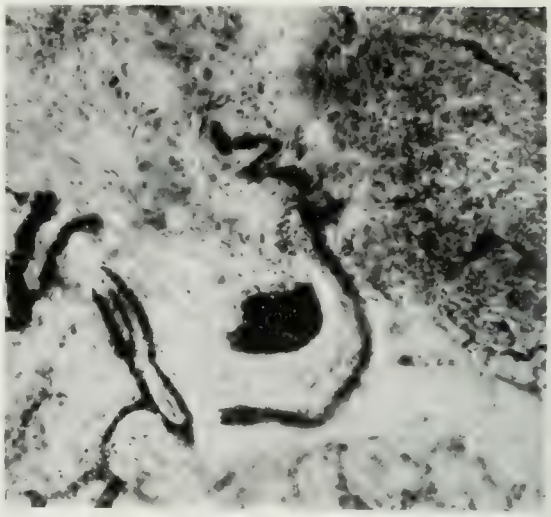

Fig. 13. Gastric type of spiral artery entering mucosa of duodenum. Branches plugged with carmin gelatin. Photomicrograph (x 100).

CONCLUSIONS

This investigation shows that the anatomic arrangements of the arteries along the lesser curvature of the stomach and throughout the first inch of the duodenum are such that the arteries are predisposed to thrombosis. The plexus of vessels in the submucosa on the lesser curvature is made up of much smaller and longer arteries without as free anastomoses as in other regions of the stomach. The branches from this plexus run a very tortuous course to enter the mucosa. The resistance offered the blood stream is constantly greater and, as a result, the blood current is slower as it enters the small arteries of the mucosa. The submucous plexus of arteries in the first inch of the duodenum is made up of relatively few vessels in comparison with other parts of the duodenum. They are small and do not anastomose freely; they

give off branches to the mucosa some of which simulate the gastric type of spiral artery. The rather limited blood supply and the gastric type of artery predispose to thrombosis. Since the vessels are more liable to be occluded by emboli, it is reasonable to suppose that they are an important factor in the production of ulcer by hæmatogenous infections.

By these observations I wish to call attention to the character and distribution of the smaller arteries in stomachs and duodenums altogether anatomically normal, and to submit the hypothesis that possibly slight deviation from the normal may contribute to peptic ulcer. In any consideration of ulcer it must be remembered that this disorder is relatively and actually rare; according to Osler ulcer is found at 1.32 per cent of all necropsies performed in the United States and in Canada. Finally, it must be remembered that high grade bacteræmias do not frequently produce gastric or duodenal ulcer.

Fig. 14. Gastric type of artery in first inch of the duodenum, giving off villus branches. The smaller cryptic branches are plugged with injecting material. Photomicrograph (x 50).

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PNEUMOPERITONEUM

By B. H. ORNDOFF, A.M., M.D., Chicago

THE purpose of this paper is to draw attention to the possibility of aid in the diagnosis of gynecological conditions afforded by the X-ray after pneumoperitoneum has been produced. Pneumoperitoneum indicates that the peritoneal cavity has been inflated with gaseous media. Medical literature shows the first record of this work in diagnosis to have been done in Europe, and that it was introduced in America by W. H. Stewart and Arthur Stein, of New York (1).

For purposes of diagnosis, it is necessary to use a sufficient amount of gas to enlarge the general peritoneal cavity to such extent that the organs may be displaced from contact with other organs and tissues. In this way the margins of the organ under consideration are contrasted for density with the gaseous media. It is obvious that by this means the outline, size, position, volume, intrinsic variation of density, etc., may be demonstrated by the X-rays.

The most important findings are exhibited in the fluorescent screen. Plates or films not only offer permanent record but because of the better detail are frequently quite necessary.

The position of the patient for examination must be such as to permit the gas to accumulate in the cavity of the true pelvis and at the same time allow the organ which is to be examined to become separated from other tissues. This may be accomplished by elevating the hips above the level of the shoulders. It is frequently necessary to palpate the organs in order that their identity and character may be revealed.

The plane at which the X-rays are used during the observations is very important. The apparatus should permit considerable variation in this regard in order that the organ may be viewed from different angles.

The examination may be carried out with the patient lying face downward while the rays are directed perpendicularly, as from the horizontal fluorescent screen apparatus. The patient may lie with the right or the left side upward, the rays being directed in a horizontal direction as before an upright fluorescent screen apparatus. The pelvis must remain elevated above the shoulders.

The gaseous media of preference is oxygen. Air, nitrogen, and carbon dioxide have been used. The amount varies from 1 to 4 liters, but there seems to be no advantage in measuring the quantity used.

The apparatus and technique used by the author were described in the *Journal* of *Roentgenology* (2).

By this method the pelvic organs, i.e., the uterus, round ligament, oviduct, and ovary may

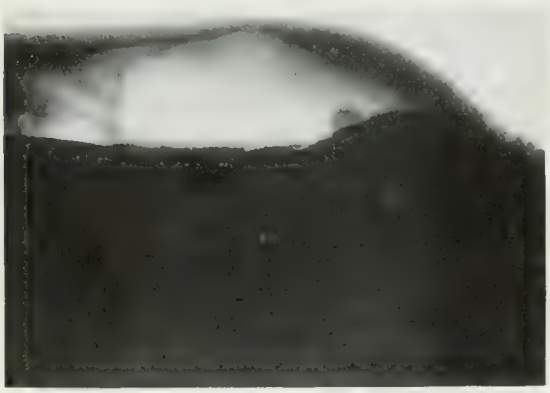

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

be visualized and palpated synchronously. The diagnostic value of thus being able to palpate from two directions any of the genital organs, that is bimanual vaginal palpation, and at the same time visualize the position, density, fixation, etc., is self-evident.

Some of the conditions in which this procedure has proved useful to the author are fibroids, pregnancy, extra-uterine pregnancy, ovarian cysts and tumors, peritoneal adhesions with visceral fixation, pyosalpinx, etc. The differential diagnosis of conditions of the rectum, bladder, ureters, intestines and other organs of the pelvis have also been greatly facilitated.

The writer wishes to express his sincere thanks for the valuable suggestions and helpful co-operation of the members of the staff of the Frances Willard hospital.

REPORT OF CASES

Case 1. No. 3534. Mrs. . . Cardinal symptoms referable to the pelvis. Dysuria and constipation were noted. The diagnosis made from physical findings was multiple myofibromata of the uterus.

Figure 1 is a lateral view roentgenogram with the patient lying face upward. The pneumoperitoneum has lifted the anterior abdominal wall far from the surface of the intestines. The iliac bone is entirely obscured by the dense shadow of the fibroid. From the margin of the fibroid a small subserous fibroid is noted, the size of an English walnut.

Case 2. No. 3432. Mrs. R. Cardinal symptoms referable to the genital organs. The patient has been married for 3 years, is 31 years old, and gives a history of scanty menstruation for 8 years. There is no history of conception which is the consideration that prompted the examination.

Figure 2 shows some of the X-ray findings. The uterus with the right oviduct is observed as a spindle-shaped body just above the pubic bones. It is observed that the uterus lies to the left of the median line, apparently because of the fixation of the left oviduct, as observed in the fluorescent screen and bimanual vaginal examination. The uterus is below normal size as observed by comparison with other illustrations.

Case 3. No. 3365. Mrs. K. Cardinal symptoms, abdominal distress but little pain. The patient gave a history of dysmenorrhœa and constipation. She has been married 8 months. It is now 2 months and 3 days since the last menstruation. Morning nausea has been noted for the past month. The outline of the proximal surface (Fig. 3) of the uterus is observed to extend rather high in the pelvis, reaching above the line of the sacral promontory as observed in the fluorescent screen with bimanual vaginal examination. Comparing this uterine outline with others in the illustration, shows the increased size very conclusively. To the left of the margin of the uterus the circular, dense, and enlarged left ovary shows distinctly. Palpation shows this ovary to be free from fixation and only slightly tender to palpation.

Case 4. No. 3366. Miss W. Cardinal symptoms, diffuse abdominal tenderness, vomiting several times daily, occasional periods of nausea, loss of weight, sensation of distention with gas in the stomach, etc.

Diagnosis from history and clinical findings did not seem rational. After the X-ray findings were reported, the diagnosis of adhesions between the abdominal viscera and the anterior abdominal wall seemed satisfactory.

Illustration (Fig. 4) is offered as showing negative genital organs.

Observations at the time of operation coincided with the conclusion drawn from the X-ray findings. The outline of the proximal surface of the uterus is detected without difficulty as it overlays the lower portion of the sacrum

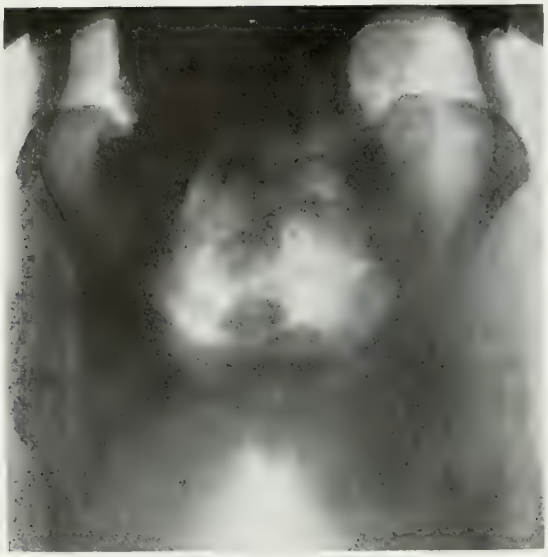

Fig. 5.

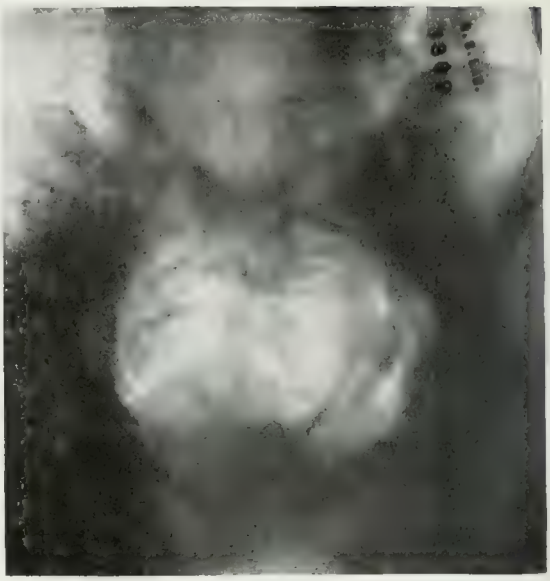

Fig. 6.

The outline is quite regular, but it appears to be broken, unless the left ovary is noticed, which overlays the left margin and somewhat the summit of the uterus. The round ligament appears as a dense narrow shadow extending from the left margin of the uterus. Crossing the shadow of the round ligament near the margin of the uterus the oviduct shows as a very faint shadow.

Case 5. No. 3347. Miss M. Cardinal symptoms are pain in the abdomen relating principally to the right iliac fossa and epigastrium, also dysmenorrhœa for many years. Recurring periods of nervous phenomena somewhat hysterical in character. Loss of weight and strength. There is constant tenderness in the right iliac region. Diagnosis, chronic appendicitis.

Figure 5 shows the findings. The uterus gives a shadow above the line of the pubic bones which is somewhat to the right of the median line. It is noted that the upper surface of the body of the uterus is abnormal in shape. The left ovary appears just above the shadow of the uterus and also somewhat to the right of the median line. It appears more dense than a normal ovary. It is also possible to discern variation of density which is accounted for by its cystic nature as shown on section following resection. The right ovary appears as a shadow on the right of the uterus and situated slightly above it to the right and slightly below the left ovary. It is less dense than the right ovary, and appears about normal in position, size and density. It was noted in the fluorescent screen and by bimanual vaginal examination that both ovaries are fixed and somewhat tender when palpated.

The findings at operation showed the left oviduct had been removed, and there were peritoneal adhesions fixing the left ovary in the position indicated in the illustration. The right ovary seemed somewhat sclerotic and was also fixed in the position indicated.

Case 6. No. 3369. Mrs. M'C. Cardinal symptoms are pain in the back, lumbar region, also in the abdomen, concentrating more particularly in the epigastrium and not exaggerated by eating; also dysmenorrhagia, dysuria, and painful defæcation probably dependent upon the presence of hæmorrhoids. Anorrhexia, myasthenia, irritating vaginal discharge, periodical pyrexia, and a history of loss of weight.

The diagnosis is chronic pyosalpinx with probably some endometritis and urethritis.

Figure 6 shows some of the X-ray findings. The dense circular shadow above the symphysis is the proximal surface of the border of the corpus uteri. Note that the uterus lies on the right of the median line. The dense narrow lines showing plainly on the left of the uterus is the round ligament. To the left of the round ligament the oviduct is observed to extend from the shadow of the uterus across the shadow of the round ligament and further to the left where it is overlapped by the shadow of the ovary. The fluorescent screen findings in conjunction with bimanual vaginal examination, indicate fixation between ovary and oviduct, which was verified at operation. The oviduct gives a shadow of less density than the round ligament. The density of the ovary is approximately that of the oviduct and uterus. On the right side the shadows of the ovary and oviduct are overlaid and confused by the shadows of the pelvic bones.

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GAS CYSTS OF THE INTESTINE[1]

Report of a Case

By HARRY G. SLOAN, M.D., Cleveland

THE first human case of gas cysts of the intestine or intestinal pneumatosis, as the condition has been designated by Turnure[2] was reported in 1876 by Bary, although since 1825 when its occurrence in an otherwise healthy pig was reported by Mayer, eight different writers have reported the occurrence of gas cysts in animals and have offered various theories regarding their etiology. Since Bary's case in 1876, 50 human cases have been reported in the literature, only two of which were in this country—one reported by Finney in 1908,[3] and Turnure's case reported in the article referred to above. In addition to these the author knows of an unreported case of Hamann. The last case to be reported is one of Tuffier's.[4]

On account of the apparent rarity of the occurrence, and the consequent lack of knowledge regarding the etiology and progress of these formations the author offers the following report:

The patient, a butler, age 32, gave a history of digestive irregularities—pain after meals and vomiting—for 15 years. During the preceding 2 months, the condition had been more active; he had been unable to retain any food, even if liquid, and had lost 30 pounds in weight. He had not vomited blood nor passed any blood in the fæces; the preceding week pain in the abdomen had become constant. The patient presented an emaciated, dehydrated appearance. His features were sunken. In the scaphoid abdomen peristaltic waves were apparent; his abdomen felt "doughy."

The fluoroscopic examination by Drs. Hill and Thomas gave evidence of obstruction at the pyloric end of the stomach. During the examination, Dr. Hill noticed an absence of the liver shadow, and therefore took a plate of the upper abdominal region to determine the exact nature of this anomaly. The picture herewith reproduced is the result. Dr. Hill tells us that in his personal observation of more than 15,000 abdominal plates he never has seen anything similar to this.

As shown by the photograph the liver shadow is replaced by a mottled appearing area showing the outline characteristic of the small intestine (Fig. 1). The autopsy finding of an unusually broad mesentery attached to this area of gut suggests that the mass of the small intestine was floated up into this position by the gas-containing cysts attached to it. The liver shadow can be made out 8 centimeters below the diaphragm, which is normal in appearance. As far as the author can discover, aside from the crepitus on palpation recorded by some observers, such a picture as this would be the only means of making a diagnosis before operation.

The patient was sent to Lakeside Hospital for hydration treatment preparatory to operation, which it was expected would be performed several days later.

On the same afternoon he experienced a sudden sharp abdominal pain. Examination showed absence of liver dullness, more tone in the right rectus muscle than in the left, with tenderness of the right rectal vault giving evidence of a perforation. Leu-

Fig. 1. Roentgenogram showing displacement of liver by floating-up of the small intestine.

[2] Ann. Surg., lvii, 811.
[3] J. Am. M. Ass., 1908, October 17, p. 1291.
[4] Bull. Acad. de méd.

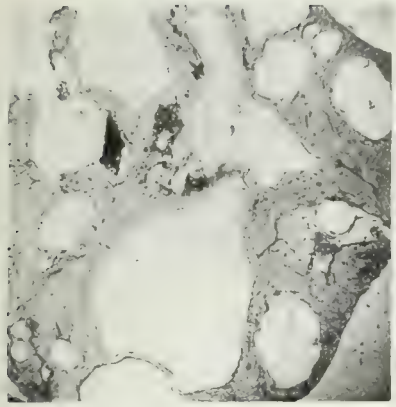
[1] In part from the Department of Pathology, Lakeside Hospital.

Fig. 2. Section of small intestine 30 centimeters above ileocæcal valve.

cocytes 15,000; rectal temperature 99.4°; pulse 132; respiration 24. Thus much against our wish, in spite of his low alkaline reserve, immediate operation became imperative. During the operation the patient gave every evidence of acidosis—rapid, shallow respiration and pale gray color. A saline infusion was given on the table. The operation was performed under complete anociation. On opening the peritoneum, gas and stomach contents escaped. The small intestine in its lower extent showed a most bizarre picture. Opposite the mesenteric attachment, there were multiple gas-containing cysts, whose walls were as thin as soap bubbles. In some areas they were matted together, sessile, 3 millimeters to 1 centimeter in diameter, over an extent of 10 to 15 centimeters (Fig. 2). Then again there were a few centimeters of intestine which showed here and there a single pedunculated vesicle hanging like a grape on its stem. In some places we saw white linear scars encircling the free border of the intestine, occupying the position of the subperitoneal intestinal lymphatic vessels where apparently spontaneous disappearance of the cysts had occurred. There was no acute inflammatory reaction in the cysts. The walls with their thin tracery of blood vessels were translucent, and only at the point where the cysts joined the pedicle, was there an opaque mother of pearl area, equal to about one-fifteenth of a cross section of the cyst. The mesenteric glands were soft and twice their normal size.

We found an old prepyloric ulcer completely obstructing the pyloric lumen, which was perforated in its anterior aspect. The stomach was extremely enlarged in size and its walls were thickened. The perforated ulcer was closed and a gastro-enterostomy was done. On account of the extremely reduced condition of the patient, a transfusion of 650 cubic centimeters of blood was given at once. The patient was put in the Fowler position, soda bicarbonate and glucose were given by rectal tap, an intravenous infusion of soda bicarbonate was given, morphine was administered in 1/6 grain doses to hold the respiration to from 12 to 16 per minute and thus conserve still further the failing reserves, and hot packs were applied. Anuria developed 6 hours after operation and death occurred the next day.

Although our prime motive in reporting this case is to note the anomalous condition described in the operative findings, it may not be out of place to insert a comment to the effect that had not the perforation forced



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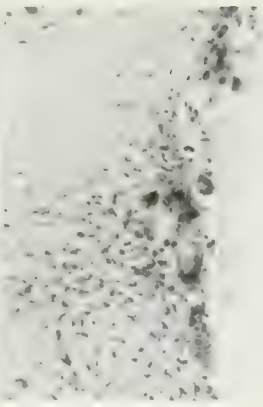

Fig. 5.

Fig. 3. Photomicrograph showing cysts in wall of ileum (x 7.5).

Fig. 4. Lining edothelium of cysts in ileum (x 675).

Fig. 5. Photomicrograph showing multinucleated cells in cyst wall in ileum (x 65).

our hand, operation upon this patient would have been deferred until, by forcing water and alkalies by rectal tap and subcutaneously, the acid-alkali balance had been restored, and the normal amount of fluid introduced into the tissues. Then the gastro-enterostomy could have been performed with a minimum of danger.

This case exemplifies the danger of allowing ourselves to forget the extreme risk of starved patients. Such cases all have a very low alkaline reserve and cannot tolerate surgical procedures until they have received fluids, glucose, and soda bicarbonate in large amounts. This patient had been slowly starving for 15 years; in addition he had continued to work up to the last moment although he was practically incapacitated by inanition.

PATHOLOGICAL REPORT

The author is indebted to Dr. Crump, assistant pathologist at Lakeside Hospital, for the following autopsy report, and to Dr. H. T. Karsner, professor of pathology, Western Reserve University, for the analysis and discussion of the histologic findings.

Autopsy findings (Dr. Crump). In the free margin of the small intestine about 20 centimeters from the ileocæcal junction of the small intestine and extending up the intestine for 60 centimeters are large numbers of air-containing cysts, with no communication between the lumen of the intestines and the cyst. The mesentery in this portion of the intestine is very loose. The cyst walls are transparent, have the appearance of peritoneum, and are very vascular. The stomach has an hour-glass appearance and is about twice its normal size. The walls are greatly thickened. In the region of the pylorus is a large ulcer which is surgically sewed and has perforated, producing a local acute peritonitis. There is present a chronic hypertrophic gastritis. Three rather large fungating ulcers are found in the pyloric region with indurated borders. The mass of scar tissue has so encroached upon the lumen of the pylorus that it is difficult to pass a probe from the stomach to the intestine. The gastro-enteric tract is otherwise negative.

In addition to these gastro-intestinal findings, there are present dilatation of the heart, passive congestion and œdema of lungs with bronchopneumonia, acute splenic hyperplasia, and passive congestion and cloudy swelling of the liver and kidneys, the latter superimposed on a slight chronic interstitial nephritis.

Histologic findings (Dr. Karsner). The microscopic sections from the ileum show in the subperitoneal coat numerous cystic areas apparently multilocular in character. The connective tissue between the cysts is increased in amount but variable as to character. For the most part it is not dense and resembles that of late granulation tissue rather than old adult tissue. In relation to some of the cysts are masses of young granulation tissue with fibroblasts in various stages of development and new capillaries. Several areas of extravasation of red blood cells are found, not especially in relation to new granulation. A moderate number of leucocytes infiltrate the tissue particularly near and in the fresh granulation. Near the peritoneal surface there is a small amount of fibrinous exudate communicating with a recent acute fibrinous peritonitis. The cysts vary in size up to 8 millimeters in diameter.

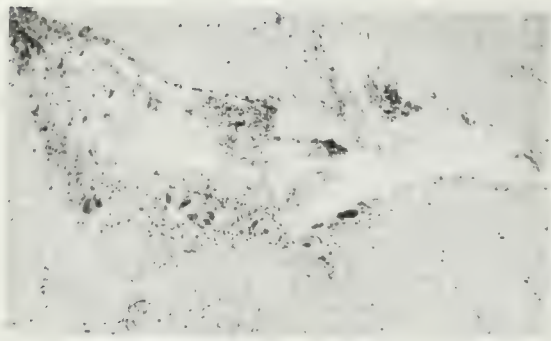

Fig. 6. Photomicrograph showing early granulation and partial obliteration of cyst in ileum (x 65).

Most of these are smooth walled, lined with a single layer of endothelium and contain a finely granular acidophilic precipitate evidently from a small amount of albuminous fluid within the cysts. Numerous cysts also show multinucleated cells continuous with the lining layer; they contain from two to a dozen nuclei resembling those of the endothelium. In certain areas the lining has almost disappeared, the cyst being small and of irregular outline and surrounded by fresh granulation tissue with giant cells toward the small cyst lumen. In a few cases the granulation tissue is older and projects into the cysts in the form of a bulb.

The muscular coats of the gut show no cysts nor do the submucous and mucous coats. There is a chronic catarrhal inflammation of the mucosa of moderate degree.

The ulcer situated at the pylorus is of chronic type with complete erosion extending into the submucosa and surrounded by dense connective tissue. In the subserosa there are 2 cysts visible to the naked eye, 1 millimeter and 3 millimeters in diameter. The smaller one shows a lining of endothelium and is partly obliterated by a bulb-like mass of old granulation extending into it similar to those in the ileum. The larger one shows no lining but is bordered by numerous multinucleated cells and an area of fairly old granulation tissue.

No bacteria are found in the histologic examination of these cystic areas.

The most important change in the heart is a marked chronic interstitial myocarditis. The lungs show marked passive congestion, œdema and a hypostatic bronchopneumonia. There is also a small tuberculous scar. The liver shows marked passive congestion, slight central hæmosiderosis and perilobular fibrosis. The spleen is the seat of marked passive congestion, slight fibrosis, and slight central arteriole hyalinization. The kidney exhibits a chronic interstitial nephritis of moderate degree, associated with marked cloudy swelling of the tubular epithelium and marked passive congestion. The adrenal shows marked passive congestion. The aorta shows moderate irregular intimal fibrosis but no change in media or adventitia.

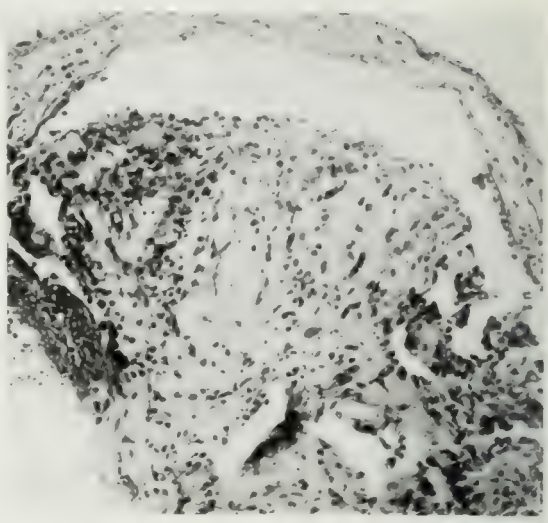

Fig. 7. Photomicrograph showing bulb-like mass of granulation partly obliterating cyst in ileum (x 145).

The pathologic examination would indicate that the condition is essentially a subacute or chronic interstitial emphysema of the gut. The tissue reaction is undoubtedly inflammatory in this case but of a subacute or subchronic nature as indicated by the relatively small number of polymorphonuclear leucocytes found. The multinucleated or "giant" cells are apparently the product of the lining cells of the cysts, show none of the characters of foreign body giant cells with inclusion bodies and are neither in morphology or distribution similar to those seen in tumors. They appear to be somewhat more resistant to destructive agents than the single lining cells as indicated by their survival in the earlier stages of granulation. Whether the inflammatory reaction is due to the presence of the gas or due to the presence of bacteria is questionable, but it is reasonable to expect that if bacteria were responsible they would be present in fairly large numbers. Bacteria are not found in the sections and it seems reasonable to assume that the gas in the cysts served as an irritant, thus leading to the inflammatory reaction. The origin of the gas must be either within the tissue spaces or from without. No analogy is known to support the assumption that the subperitoneal tissue produces gas in free form, nor is there any analogy to support the assumption that a tumor may produce free gas. Production of gas in tissues as a result of putrefaction is accompanied by the presence of bacteria in considerable numbers and the gas-forming bacteria of wound infections are active only in the presence of some necrosis and even under these circumstances the tissues show a considerable number of organisms. This argument leaves open for discussion the hypothesis that the gas is introduced from without. An opening for such introduction of gas exists in this

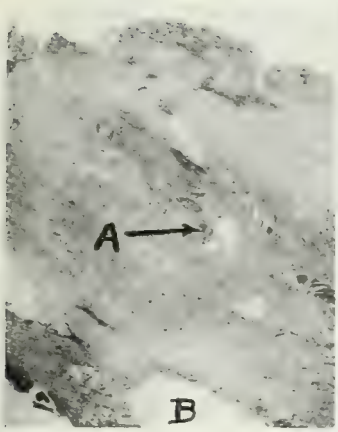

Fig. 8.

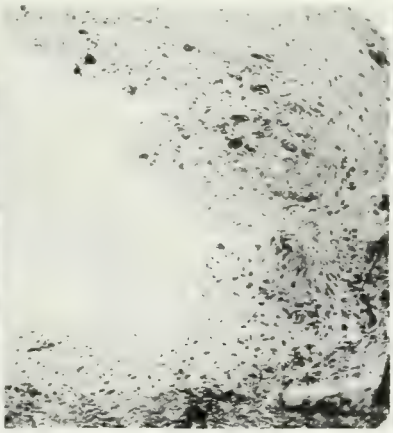

Fig. 9.

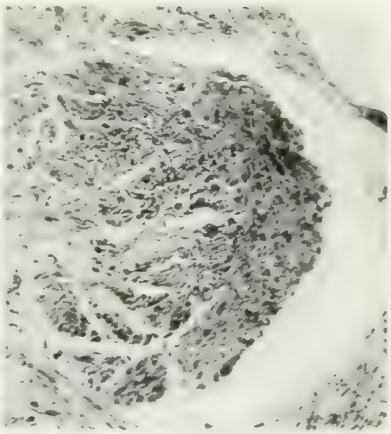

Fig. 10.

Fig. 8. Photomicrograph showing wall of stomach under gastric ulcer; at *A* a partly obliterated cyst and at *B* a cyst in the stage of early organization (x 7.5).

Fig. 9. Photomicrograph showing early granulation and multinucleated cells in wall of larger cyst in stomach wall shown at *B* in Fig. 8 (x 65).

Fig. 10. Bulb-like mass of old granulation tissue partly obliterating cyst in stomach wall shown at *A* in Fig. 8 (x110).

case in the gastric ulcer. Entering at such a point probably under the pressure influence of gastric muscular contraction on a volume of gas, the mode of transit to the ileum can best be explained by peristaltic action. Supporting this idea is the finding of old, more or less cicatrized, cysts in the subserosa of the stomach and more recent cysts with little inflammatory change in the lower small intestine, although in this latter situation there are also older cysts. Progress would be by paths of least resistance, namely through tissue spaces and lymphatics. Even were tissue spaces enlarged by bubbles of gas they would soon become lined with endothelium and become indistinguishable from larger lymphatic vessels. Independently of accompanying infection the gas could act as a foreign body and lead to the inflammatory reaction seen in the specimens. The subchronic nature of the inflammation leads to the view that the reaction is that of the tissues to the presence of the gas rather than that induced by bacterial infection.

ETIOLOGY

In addition to the above discussion, Dr. Karsner contributes the following regarding the etiology of gas cysts of the intestine.

There are three theories of etiology: mechanical, bacterial and neoplastic.

The neoplastic theory was suggested by Bang and has against it the frequent spontaneous disappearance of the cysts with cicatrization. MacCallum, in Finney's case, suggests that certain vacuolated cells might give origin to the gas. Had his studies shown that the material in the vacuolated cells was gas and not the more usual substances found in vacuolated cells his proposition might be more convincing. Definitely against such an assumption is the absence of description of such cells in many other reports and a complete failure to find them in our case. Kouskow's idea that the giant cells are specific formers of gas is opposed by the fact that the larger cysts show no giant cells and the giant cells are most numerous in the cysts which are reduced in gas content.

The bacterial theory is opposed by the numerous instances in which anaerobic and aerobic cultures have been negative. Furthermore, the wide variations in types of bacteria formed suggest contamination of intestinal origin.

Tuffier opposes the mechanical theory on the basis of the fact that certain cases failed to show a point of entry for the gas. On the other hand a large majority of the reported cases have shown a possible point of entry, via a gastric ulcer or a tuberculous one. Knowing how fine a needle puncture may lead to interstitial emphysema of the chest wall and how small a lesion of the lung may lead to interstitial emphysema, it is easily within reason to consider that those cases of gas cyst failing to show gross lesion might have had their origin in a lesion small enough to escape the notice of the surgeon or pathologist.

The analyses of the gas so far published are contradictory and incomplete. The gas found by Jager with high hydrogen concentration might be intestinal gas, that of Luiz might be air and that of Urban is extremely incomplete. Perhaps all these investigators worked with too small amounts of gas to permit of satisfactory and complete analyses.

CONCLUSION

The etiology of the case reported above is best explained on the mechanical theory.

RHINOPHYMA [1]

By M. G. SEELIG, M.D., F.A.C.S., St. Louis

RHINOPHYMA is an essential disease of the nose, of more than ordinary interest. The gross characteristics of the disease and the resultant disfigurement are, in the first instance, striking. From the purely clinical side, the uncertain and possible multiplicity of etiological factors adds interest. From the pathological side there is presented the interesting problem of deciding whether to classify the disease as an inflammatory hypertrophy or as a frank neoplasm, and finally, from the historical point of view, the disease simulates unusual and fascinating interest, owing to the part played by the old masters of classical painting and satire in picturing the disease on canvas and in prints.

From the clinical side, rhinophyma might be described fairly accurately if one merely set down the various descriptive terms which have been used in naming the disease: whiskey nose, pound nose, nodular nose, growing nose, copper nose, elephantiasis of the nose, hypertrophy of the nose, lymphangioma, acne hyperplastica, fibroma molluscum and cyst-adeno-fibroma. In the earliest stage of the disease the nose is a dark copper red, and there are dark red spots about it, particularly on the cheeks and at the glabella. Gradually there appear on the nose lentil-size to pea-size discrete or confluent nodules. As these nodules coalesce, and the soft parts hypertrophy, the whole organ becomes deformed by the tumor-like nodules. The deforming growths occur usually at the tip and on both alæ, and may be discrete and lobulated, or they may fuse, forming one large knob. Sometimes they are pedunculated. Von Bruns reports a case in which the growth reached to the chin, and had to be held aside when the patient partook of food or drink. As a rule there are only three irregularly rounded lobulated growths situated at tip and alæ but sometimes there are many small lobes separated by deep furrows. The nodules are usually soft and are coursed by dilated veins, and studded with comedoes and acne pustules. Owing to the activity of the sebaceous glands, the surface of the nose presents an oily varnished appearance, and seems to be pitted by the wide open mouths of these glands. Pressure on the nodules causes macaroni-like plugs of sebum to worm out from the sebaceous glands.

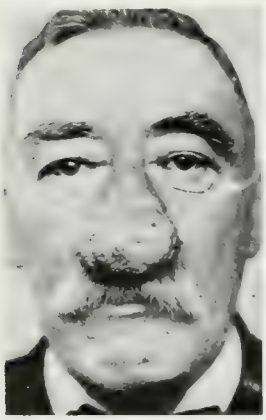

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 1. Rhinophyma before operation.
Fig. 2. Profile, same patient.
Fig. 3. Same patient after operation.
Fig. 4. Profile, same patient after operation.

[1] Read at the meeting of the Western Surgical Association, Kansas City, December, 1919

Fig. 5.

Fig. 6.

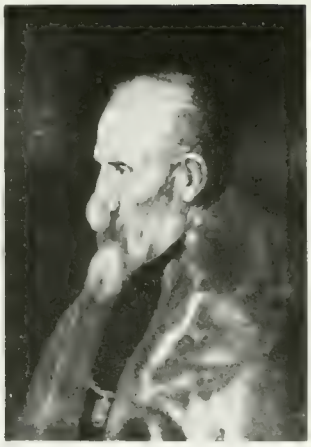

Fig. 7.

Fig. 5. Unknown subject, painted by Holbein the younger (1497-1553). Hangs in the Prado of Madrid. (From *Hollaender.*)

Fig. 6. Portrait of supposed grandfather and grandchild by Ghirlandajo (1449-1494). Hangs in the Louvre. (From *Hollaender.*

Fig. 7. Unknown sitter by a Holland master, in Museum at Stockholm. (From *Hollaender.*)

The disease occurs usually in the fifth and sixth decades, that is, the deformity is complete at these periods, the process having taken five to twenty years to develop fully.

There probably is no relationship between the disease and alcoholism. An analysis of the cases shows that there is an infinitesimally small number, compared with the number of alcoholics; and that many cases of rhinophyma occur in non-drinkers.

The commonly accepted opinion is that rhinophyma, pathologically speaking, represents the terminal stage of acne rosacea that has passed through acne hypertrophica. In many instances the disease seems to rest on a congenital basis; Lassar believed that there was a predisposition to rhinophyma in wide-pored individuals. The essential pathological process is an hyperplasia of the connective tissue of the soft parts of the nose, accompanied by a dilatation of the blood vessels, and hypertrophy or cystic degeneration of the sebaceous glands. The skin follicles show, in places, distinct evidences of suppuration. The openings of follicles and of the ducts of the sebaceous glands are widened, so that they resemble deeply-pitted pores, often giving to the nose the appearance of a sponge. No one has ever satisfactorily demonstrated the cause of the disease. Kaposi sought to prove that the connective-tissue growth, blood-vessel dilatation, and sebaceous-gland degeneration, were all secondary to an angioneurosis; but there is no marked consensus of opinion concerning this theory. Trendelenburg considered the disease as a new-growth and grouped it under the head of fibroma molluscum; Lassar considered it a cysto-adeno-fibroma.

I am indebted to Dr. Martin Engman for the privilege of quoting from the advance sheets of his forthcoming book on *Diseases of the Skin*. Dr. Engman, from an intensive study of rhinophyma, draws the following conclusions regarding the pathology of the disease. "Rhinophyma is a familial disease representing some type of hereditary transmission. It occurs usually in the seborrhœic type of individual. (The seborrhœic type of Sabouraud may be described as an individual with yellowish-tinted, muddy, thick skin, the yellowish tint being most pronounced around seborrhœic areas, with a tendency to acne vulgaris in youth and acne rosacea in middle life.) The future rhinophyma subject shows a tendency toward flushing of the face, on entering a warm room, after meals, or under excitement. This flushing leads, in time, to a chronic congestion, with secondary chronic infection of the skin of the nose and

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 8. Print of Gerhard Janssen, an old glass etcher of the middle 17th Century. (From *Hollaender.*)

Fig. 9. A caricature from the 17th century. One of the so-called Kings of Noses. (From *Hollaender.*)

Fig. 10. A caricature of a physician, published about 1700 in Augsburg. (See text for translation of legend.) (From *Hollaender.*)

sometimes of the cheeks. This in turn leads to a chronic productive inflammation, with vascular dilation, connective-tissue formation, and dilation of the sebaceous glands into cyst formations. There is a marked thickening of the cutis vera, which throws the skin into folds and furrows. The end-result is the multiple formation of knobs or tumor-like masses."

The treatment of the disease is exclusively operative. The occasional recommendation to practice wedge-shaped excisions, should be ignored. The most satisfactory operative procedure consists in shaving off the redundant tissue until the nose is brought back to what one assumes was its original form. In this shaving process, two things should be borne carefully in mind: (1) do not shave too deeply, and (2) preserve a thin rim of epithelium around the nares. If the shaving is carried too deeply, we remove all sebaceous-gland rests and leave no niduses of epithelium from which, as brood centers, epithelization may spread. This delays healing, and even if the nose be grafted, the resultant skin has a harsh, white, dry appearance so striking as always to command attention and cause comment. Furthermore deep shaving may injure the nasal cartilages and set up a stubborn perichondritis. If a thin ring of intact skin is not left around the nares, serious disfigurement may result from the contractions incident to cicatrization. Hæmorrhage, which is usually very free, is checked with comparative ease by simple gauze pressure, and the patient is sent to bed with a large, well vaselined gauze pad over his nose. The next day this pad is removed, and the denuded area is strapped with imbricated strips of sterile zinc oxide adhesive plaster. This plaster dressing is changed daily. Under this simple dressing, my patient, shown in Figures 1 to 4, was completely healed in ten days. It is not necessary to skin graft these patients. Indeed von Bruns points out that grafting often leads to the development of retention cysts underneath the grafts, with subsequent breaking through and ulceration.

The rôle that rhinophyma plays in medical history and in classical medical art and caricature is not totally without interest even to a group of practical surgeons. Dr. Eugen Hollaender in his two volumes devoted to *Medicine in Classical Art*, and *Caricature and Satire in Medicine* furnishes some striking copies of pictures that feature rhinophyma.

Hans Holbein, 1497-1553 (known as Holbein the younger) famous in medical art as

the painter of the Dance of Death, painted the portrait of an unknown subject (Fig. 5). The portrait, which hangs in the Prado at Madrid, shows an old man, with a typical rhinophyma, and the characteristic red, congested color scheme which goes with this disease. Hollaender states that the coloring seems to have been toned down by the artist, in order to minimize the existence of the disease as much as possible.

Domenico Ghirlandajo, 1449-1494, the famous Florentine artist, has a picture in the Louvre illustrating rhinophyma even more typically (Fig. 6). Hollaender's speculations on this particular picture are interesting rather than convincing. He queries as to whether the small tumor on the right brow of the old gentleman may not be intended as a metastasis, thus hinting at the possible belief that rhinophyma was at that time considered to be malignant. Then further, he speculates as to whether the beautiful child's head was intended to soften, by contrast, the jarring asymmetry of the bulbous nose of the old gentleman, or whether the perfect featured little granddaughter was used to disprove the familial nature of the disease.

Hollaender presents these two pictures (Figs. 5 and 6) and the picture by an unknown Holland master (in the museum at Stockholm, Fig. 7) to illustrate the fact that they are pure portraiture, artistically executed without a semblance of caricature. These portraits may stimulate a sense of sympathy but they make no appeal whatsoever to the risible in our make-up.

By contrast, Figure 8 leads away from art, into the field of caricature. This old rhinophyma subject, Gerhard Janssen by name, was a master glass etcher, born in Holland and trained in his art at Dresden, 1650-54. The pr'nt itself is not a caricature, but the descriptive phrases engraved about it[1] furnish

[1] The legend about the frame is as follows

A mis-shapen nose indeed, but a man of talent and wisdom. Art, work, and industry bring praise and reward.

The legend underneath the picture is:

Herr Gerhard Janssen, former court glass painter, and also experienced in the Damascan art of glass etching. Born in Utrecht, Holland, 1636, July 21; studied at Vreden in Westphalia, from 1650 to 1654. Removed to Vienna in 1662 where he died in 1725, June 3, at the age of eighty-eight years, ten months and eight days. God rest his soul. This print drawn and etched July 25, 1725 by U. D. Metzger, learned in this art, from Speyer, in the Palitinate but at this time residing in Maria Hof, fifteen minutes from Vienna.

Fig. 11. Chief Wa-Ha-Gun-Ta (American name is Capt. John Smith) of the Chippewas. Still living, and an active hunter in Glacier Park, at an approximate age of 127 years. Rhinophyma is fairly common in American Indians.

a caricaturish setting; such phrases, for example as the legend just above the head, *Nasutus sed acutus* (large nosed but wise) and the sentence in the frame, "*Es ist wahr ein unfoermliche Nase. aber sinnreicher Verstand* (a misshapen nose, 'tis true, but talented and wise).

The next two prints are frank caricatures. Figure 9 is from an old 17th century pamphlet and is a simon-pure bit of what Hollaender ca ls naive lack of humor of this period. This king of The Large Nosed stands surrounded by all sorts of impossible things, people, animals, a large horn, a mercury's staff, a shepherd's staff, ships, etc., and points proudly to his rhinophymistic organ.

Figure 10 is an even grosser caricature, and represents the tendency at this particular time (late 1600) to use the doctor as a scapegoat and harlequin in jokes and on the stage. This large-nosed doctor, with what might be

construed as a rhinophyma knob at the proximal and middle third of his proboscis proclaims:

"For healthy people, I am a doctor, God help the Sick.
My large head gear embraces profound and numerous thoughts.
My costume connotes the art that I possess.
What may be concealed in the urine, my long nose detects."

And finally, Figure 11 is not without interest from an ethnological point of view. Rhinophyma is fairly common in the American Indian. This is a portrait of Wa-Ha-Gun-Ta chief of the Chippewas (photographed by Mr. William Burton of St. Louis, who kindly loaned me this copy). There are authentic records to show that the chief is about 127 years old, and as far as the memory of man runs he has had a typical rhinophyma.

ABDOMINAL SURGERY IN THE CASUALTY CLEARING STATION AND EVACUATION HOSPITAL[1]

By WILLIAM M. THOMPSON, M.D., F.A.C.S., Chicago

IT is quite as important to bring the literature of war surgery up-to-date as it is to revise the manual of the medical corps. This has been done, but not in an organized manner as to the treatment of war wounds at the base and reconstruction hospitals. However, nothing has been done to collect and correlate the results of our experiences and knowledge of the primary surgery of the front that makes possible successful reconstruction work and has the largest influence in the weal or woe of the sufferer from war wounds.

If the surgeons of future wars are to profit by the wealth of our experience, it is our duty to set down what we know of methods that have given the best results as well as our ideas of any improvements that may be made in the evacuation of wounded and the technique of the surgery of war wounds.

The Civil War saw the beginning of laparotomy in the treatment of war wounds, but it was fraught with even more disastrous results than peace time laparotomy of that day. Because of this later development of surgical science, we have only the more recent wars to draw conclusions from, the war in the Transvaal, Chino-Japanese, Russo-Japanese, Cuban, and the World War of 1914–1918. It will be seen from a perusal of the statistics of these wars that the evolution of ideas of treatment of the wounded has not progressed steadily toward a definite formula of surgical attack but that opinion has fluctuated from one extreme to the other. (In a paper of this sort space forbids discussion of the Murphy operation or any of the other half way methods.) But gradually one notices at each successive forward wave a slight improvement in results as shown by statistics.

In a given surgical unit properly equipped, there are four reasons for this fluctuation: (1) the distance and mode of transportation from the battlefield to the surgeon; (2) the time elapsed before the wounded man is operated upon; (3) the type of missile; (4) the character of the wound.

Experience has proved that every hour is precious in dealing with an acute abdomen, for certainly we must class all war wounds as highly acute; also jolting over shell holes helps to distribute the contents of the intestinal canal rent by shell fragments. It must be borne in mind in comparing the damage by different missiles that high explosive shell fragments rank first, and that aerial bombs and hand grenades are classed along with high explosive. Next in order come bullets and last, shrapnel balls. The great war saw the introduction of high explosive bombs and grenades. Previous wars had only to contend with the other form of wounds, but the use of smokeless powder in this war has speeded the

[1] Read before the Chicago Genecological Society, December 19, 1919. (For discussion, see p. 417)

bullet up and made it more destructive to tissue and bone. One can be easily misled if one relies on bare statistics to form an opinion of the mortality of operated upon versus non-operated upon wounds.

In one series from French reports where non-operative interference was practiced there were 713 cases, with 550 deaths and 163 recoveries, the mortality being 72.2 per cent. Of those subjected to laparotomy, in a series of 688 cases there were 249 recoveries, or 36 per cent; and 439 deaths, or 64 per cent. Of this series there were 251 cases of lesions of the small intestine, with 75 recoveries, or 70 per cent mortality. But these figures are open to the following criticism: (1) the unknown number who died before reaching the operating station. (2) Those whose wounds did not penetrate the peritoneal cavity in the non-operated upon series might easily be mistaken for penetrating; for example, working in conjunction with a French ambulance in the battle at Chateau Thierry, a French officer refused to operate upon an abdomen on the ground that it was penetrating and inoperable. I differed with him, and he said go ahead, so we changed tables. I found the wound non-penetrating, partly girdling the right side just external to the peritoneum but destroying much muscle. The man recovered. (3) Visceral lesions, as for instance, those of the liver when made by bullet or small shell fragments seldom need operation. I had 12 cases of entrance and exit liver wounds in my wards at one time that recovered without surgical treatment. (4) Deferred laparotomies, usually operated upon at the base when the lesion becomes localized and can then be treated by the stab wound and drainage method. (5) Entrance and exit wounds of the outer border of ascending and descending colon with sufficient drainage.

Thus it will be seen that certain cases do recover when not operated upon, but we still have a large percentage of those with perforation of the small intestine, stomach, transverse colon, rectum, gall-bladder, and in addition those suffering from internal hæmorrhages who are doomed without operation. This class of cases only serves to emphasize the necessity for a careful *triage* or sorting of all wounded at the dressing station. These patients and those with compound fractures of the femur and with chest wounds, as well as those with thoraco-abdominal wounds, should be collected and sent directly to operating stations equipped for such cases. When an abdominal case comes in, it is better not to wait until there are enough cases to fill the ambulance, but send it on at once, as hours are precious.

In addition to the four causes of failure in laparotomies in previous wars, in this war, there has been an additional cause, the bombing of hospitals by night. It has been my observation that nothing in an advanced hospital adds more to the shock already suffered by these patients than serious night bombing.

In our earlier wars and frequently in the great war, laparotomy often disappointed the hopes of the most favorably inclined surgeons but, on the other hand, a careful analysis of statistics demonstrates the success of non-interference to be much rarer than had been thought.

In my experience in this war, I have observed three periods that have largely influenced the statistics of laparotomy. The first period was in 1917 when trench fighting attacks and counter-attacks were common, but there was no great fluctuation of the lines. During this sort of fighting more favorable results followed laparotomy because the casualty clearing station could be better situated, was moved less frequently and better surroundings and equipment could be had, as it was not necessary to be ready to move on short notice. The second was the period of retreat, during the spring of 1918. During this time results from laparotomy were unfavorable. The organizations sometimes lost much of their equipment and had of necessity to evacuate many cases that might have been saved if there had been time to operate and if there had been a place of comparative safety for the patients to convalesce before evacuation. In the first period, a rail head was always at hand by which in 24 hours after operation we evacuated nearly all the cases comfortably. In the second period, rail heads, if they were at hand, were choked with

all sorts of combatants and material, and, at other times they had been put out of use so that resort to ambulance transport was the only means of evacuation, a painful process, adding to the mortality. In the third period of rapid advance, the hospitals were unable to keep up with the army, necessitating long transport and delay; and this was unfavorable to the best results in abdominal wounds.

It is agreed that the treatment of selected abdominal wounds is laparotomy. Let us next consider the conditions and surroundings necessary for success. As I stated in a previous paragraph, the cases must be selected at the dressing station. The work must be done by a surgeon of large experience and sound judgment. Too much emphasis cannot be laid on the necessity of selecting such a man. Other wounds, as of the head and extremities, except of femurs, can wait if hæmorrhage is controlled and splints applied until a sufficient number has accumulated to fill an ambulance, but sucking chest wounds, abdominal wounds and injuries of the femur should be given the preference in transportation. The *triage* officer should classify his abdominal lesions about as follows:

1. A certain number cannot recover under any conditions. These should be set to one side and given morphine to make their last hours as comfortable as possible.

2. Abdomino-thoracic lesions are usually extremely serious unless traversing the lower thorax and involving only the diaphragm and liver. The serious ones should be immediately evacuated if they can make the trip safely.

3. Multivisceral wounds of the abdomen are more serious and should be evacuated rapidly.

4. A certain number of visceral lesions may recover spontaneously as has been mentioned before—entrance and exit wounds of the liver. These can usually be collected with other of the less serious cases and transported in bulk.

5. There are some visceral lesions that cannot possibly heal spontaneously and should be classed among those needing immediate transportation.

6. A certain number of penetrating wounds that do not affect any viscera, even when the abdomen is traversed from one side to the other, cannot be easily differentiated from the serious. They should be classed with the serious and immediately transported.

7. Those wounds that are plainly non-penetrating can be sent down with other wounds.

Now there are four classes out of seven that should be given preference in transportation, and this is usually possible except under circumstances when, so to speak, the bars are down and the flood of wounded pours in and the medical department appears to be swamped. This is the time when training and discipline, which are a part of preparedness, score high. Out of disorder begins to appear order and system. Every man knows his duty and does it; transport in all forms from trucks to ambulances having been previously arranged for come up and the field is gradually cleared.

The next stop is the field hospital. The ambulance corps which has charge of the dressing station and the transportation of the wounded from there to the field hospital has five medical officers, but experience has shown that most of the work done by them, that of commanding and supervising transportation, could be done by a layman, and at least two of the surgeons added to the staff of the field hospital. At times in this war it was necessary for a field hospital to assume the functions of an evacuation hospital. There was nearly always a dearth of surgeons and supplies when they were most needed.

It is my belief that in the majority of instances the field hospital is the point at which the four classes of abdominal wounds should be held and arrangements perfected for their surgical care. We have shown the importance of early operation and unless the evacuation hospital is close up, a loss of time ensues which may be fatal to many. This does not deprive the evacuation hospital of its position as the center of surgical activity of the advance, as in the plan I am about to outline only the non-transportables, as we may class those enumerated above, are held at the field hospital. This plan does not obliterate

the mobile unit but retains it in an even more mobile state to re-enforce evacuation hospitals on the eve of a heavy engagement.

There should be added to the commissioned personnel, one surgical team as part of the permanent staff of the field hospital which would be adequate for taking care of all non-transportables when the front is fairly quiet. All of you who have served in advance hospitals know the difficulties of securing transportation for surgical teams in times of stress. You also know that when a request for surgical teams goes in through channels—general headquarters—and from there an order goes out to the teams to move, because of the scarcity of motor transport, the teams have to take a circuitous rail route and that they often arrive after the battle is over and the work cleaned up. Let us then take a sufficient number of teams and put each of them on wheels consisting of one ambulance for baggage and personnel, the ambulance to be attached to the field hospital as long as the team remains for the transport of wounded; a motor truck which will carry a compact, full operating-room equipment, sterilizer, etc., also a small take-down portable room that is standardized.

Army regulations make a field hospital a divisional organization. This is all very well when a division is acting independently, but as part of an army corps, orders should come directly from corps headquarters, thus saving time, and when the division is at rest the hospital can still carry on, taking some of the work from other divisions that are in combat. All teams and hospitals should be directly under centralized authority in the zone of advance. The officer commanding should sit in his office and should receive frequent reports of the condition of each hospital. He should know how to anticipate a big push and be in direct communication with all his teams.

On reaching the field hospital the abdominal case again passes through the *triage*. As is natural, the most serious cases are examined first. From the notes on the label the *triage* officer ascertains the time of the wound and cause (missile). He looks for pain, vomiting, position of wound, stool and micturition. His examination should include an inspection of the point of entrance, and exit if there be any, of the missile; the contraction due to rigidity, whether general or local; examine the flanks for fluid. The facial expression is a help in making the diagnosis; also the color of the skin and mucous membranes; cold, clammy, or sweaty skin; dark circles around the eyes; cold extremities; dyspnœa or restlessness, and lastly, the pulse and temperature. I am not in favor of probing the wound.

These questions answered will usually enable the surgeon to determine whether the wounds are penetrating, and if penetrating, what important viscera are injured, and finally, if the case is operable. If pain, pallor, cold sweat, rapid thready pulse, anxiety, restlessness, suggest that in addition there is concealed hæmorrhage, then this case takes precedence over all others and should be rushed immediately to the operating theater without taking time for radioscopy, as the case is rapidly prepared for operation. Arrangements are made simultaneously to transfuse, using citrated blood from one of the gassed cases. If the surgeon is satisfied that there is no hæmorrhage, but that the symptoms manifested are those of what we call shock, then it may be best to send the patient to the shock ward, where heat is applied, hot drinks administered, and transfusion practiced. The patient is returned to the theater as soon as the shock team is satisfied that his condition will warrant an operation.

The relation between the shock ward and the surgical department should be so close that they dovetail into one another.

I have mentioned transfusion for shock, and I appreciate that it may sound unusual to civil surgeons, but in civil surgery we seldom see such severe degrees of shock as we do in war. Let me say to those who have never witnessed it, that a compounded fracture of the femur may cause the most severe shock. After my experience in watching the work of the shock teams in evacuation hospital No. 110, I would even go farther and transfuse, not only for hæmorrhage and shock but also for severe sepsis.

No attempt should be made to operate in the presence of severe shock. Finally, no surgeon should allow his feelings to dominate his judgment and pass cases that are clearly beyond surgical aid on to the operating room. He should consider that all the efforts of the surgeons are being used to save those who can be saved.

Passing through the X-ray to the operating room, we will consider the technique of laparotomy. This is such a large subject, that it would take at least a paper to do it justice, so I shall mention only a few of the important principles. The first is speed without hurrying by avoiding all false moves and fancy methods. Two sets of instruments are necessary, one to excise the damaged skin and muscle and clean the wounds, for we must make every effort to secure the best possible asepsis. The abdomen is usually opened at a point that will most easily permit the exploration to get at damaged viscera. The incision should be ample. Muscles should be cut across when necessary. Sources of infection are encountered, one from the dirt and clothing carried in by the projectile itself, the other from intestinal contents. The same rule that holds in civil surgery holds here regarding wounds of the lower intestinal tract, that they are more infectious. Bullet wounds are, as a rule, cleaner than high explosive wounds because of the ragged edges and rotation do the most damage. The liver will stand a good deal of surgery if no large vessels are injured. The spleen may be plugged if the hole is small; also the kidney, but if the wound is large and ragged, the organ must be removed.

Intestinal injuries from projectiles differ from abdominal infections of civil practice in that we are in the presence of fresh injuries. There are no adhesions, and peritonitis has not had time to interfere greatly with the nutrition of the gut, so that intestinal sutures that would not hold in civil surgery will often do remarkably well. For this reason one does not need to resect as frequently, and this is fortunate as it increases the mortality. End-to-end anastomosis is the rule. One of the greatest difficulties to handle is laceration of the splenic flexure of the large intestine and the hepatic flexure ranks next. Transverse wounds involving the diaphragm are easily sutured through openings in the thorax.

In thoraco-abdominal wounds, the thorax should be attacked first and closed before opening the abdomen. Many perforating wounds of the small intestine need only a circular suture. It is gratifying to see how well these wounds do even when the intestine is considerably reduced in caliber.

Closure should be with through-and-through sutures, either of wire or silkworm gut, care being taken to draw the peritoneum well into the wound. There is no debate on this procedure.

Drainage is always safest. The surgeon should content himself with doing just enough to save the patient, and not allow his enthusiasm to carry him into operative procedures requiring time and great skill when simple methods will do.

I have said nothing about searching for the foreign body purposely, because bringing up that question at this point serves to add emphasis. After inspecting the abdomen the injured intestines are clamped and surrounded by moist packs and the abdomen well cleansed. If the foreign body is found during this inspection, remove it; if not, do not waste time, but proceed with the operation. If the foreign body is where it will do serious harm, it is usually easily found. If not, it becomes encysted by omentum or inflammatory tissue later on.

Many of these patients should be returned to the shock ward where, as in all abdominal operations, the Fowler position and saline drip are routine.

I have passed over injuries of the urinary bladder, rectum, and pelvic bones. This is a large subject by itself, as is also the subject of abdominal wounds complicated by injuries to the spine.

DEPARTMENT OF TECHNIQUE

THE UTILIZATION OF THE TRANSPOSED UTERUS FOR THE CURE OF EXTENSIVE VESICOVAGINAL FISTULA

Report of Case

By CHARLES E. DOWMAN, A.B., M.D., F.A.C.S., Atlanta, Georgia

IN November, 1910, there was referred to me a woman, 26 years of age, who had the most extensive vesicouterovaginal fistula which I had ever seen. Three months previous to my examination the patient had given birth to a full-term child. At this time she had been attended by a midwife who had allowed her to remain in labor for 6 days. A physician was then called and removed a dead child by means of forceps. Following this delivery the patient had a constant dripping of urine from the vagina, and no longer voided in the normal way. On examination I found the condition represented in illustrations 1 and 2. There had evidently been an extensive necrosis (due to the pressure of the child's head), of the anterior portion of the cervix and anterior vaginal wall, with complete destruction of almost the entire posterior wall of the bladder. This necrosis fortunately had not involved the ureters, but had extended down as far as the trigonum. The necrotic mass had sloughed away, leaving a clean-cut opening with smooth healed edges. In spite of this history and the condition found on examination, the patient's general health was good.

After considering the technical difficulties of closing such an extensive fistula, and with the full realization that whatever methods might be employed, the chances of success were very slight, I decided to operate; and the following method was adopted:

With the patient in the lithotomy position, an incision was made at the junction of the

Fig. 1.

Fig. 2.

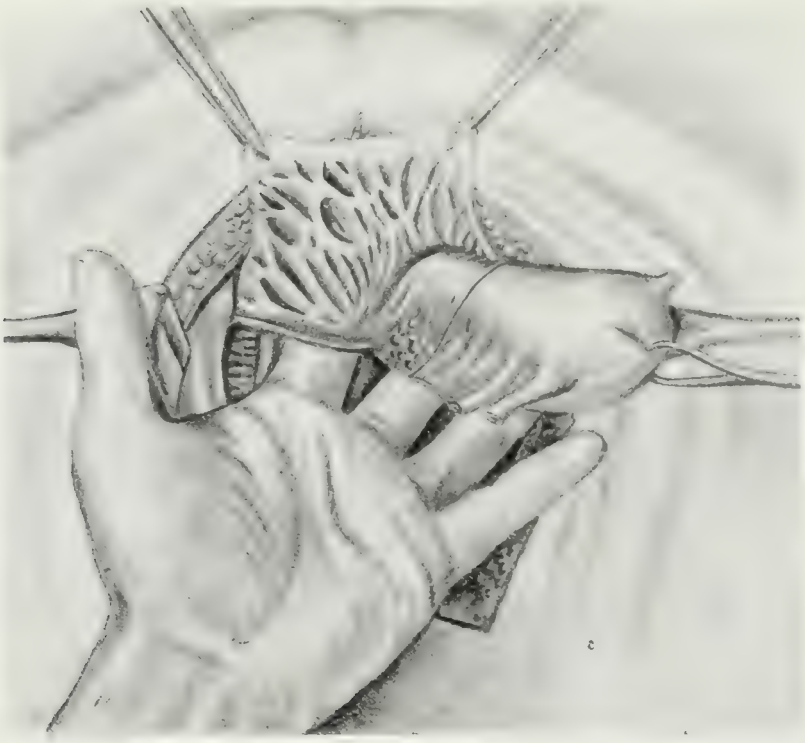

Fig. 3.

bladder and vaginal mucous membrane, and the bladder wall freed extensively from the anterior wall of the vagina, well out to either side and below toward the trigonum. The denuded areas

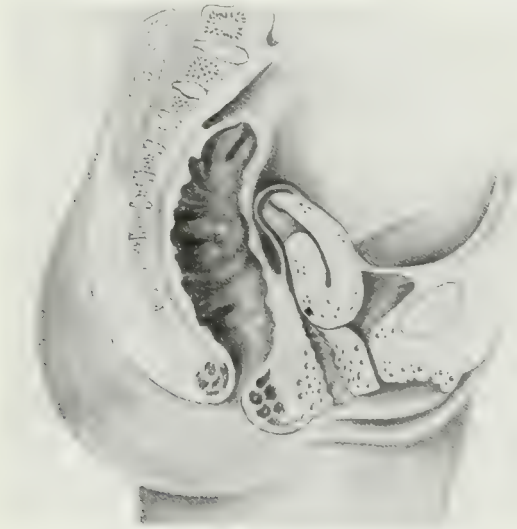

Fig. 4.

were packed with gauze and the patient placed in the Trendelenburg position. The abdomen was opened by means of a mid-line incision and the pelvic organs exposed. The tubes, round ligaments, and broad ligaments were divided between ligatures on either side, and the bladder opened at its attachment to the anterior wall of the uterus. The dissection was continued until the bladder was completely freed of all uterine attachment. The uterus was placed in an extreme anteverted position so that the posterior wall of the fundus could be utilized as the posterior wall of the reconstructed bladder. That part of the bladder wall which was thus accessible through the abdominal opening was sutured to the posterior surface of the uterus, by means of chromic catgut sutures, in such a manner as to bring the mucous membrane of the bladder in contact with and approximated to the peritoneal covering of the uterus. These sutures were placed through the bladder wall but not through the bladder mucosa, so as to avoid any of the sutures being exposed in the bladder cavity. This line of sutures was re-enforced by a second layer of catgut sutures. The abdomen was closed and the patient again placed in the lithotomy

position. Through the vagina the operation was completed by continuing the approximation of the bladder wall to the peritoneal surface of the uterus by means of similar layers of sutures. Figures 3 and 4 show in a diagrammatic way how the above was accomplished. A retention catheter was placed in the urethra.

Following the removal of the catheter 6 days later the patient began to void normally and had no leakage of urine whatsoever from the vagina. Three weeks following the operation she was allowed to return home. Three months later the bladder was inspected through a Kelly cystoscope. The normal bladder and that part of the uterus which formed its posterior wall could hardly be differentiated. The patient was last seen 6 years later and seemed healthy in all respects. Her bladder had given her no further trouble.

Fortunately, such an extensive vesicovaginal fistula as existed in the above case is of very rare occurrence. During the nine years which have elapsed since operating upon this patient I have not seen a fistula so extensive as to necessitate utilizing the uterus in effecting a closure. In this particular case, however, I know of no other method of bladder reconstruction which could have given such a satisfactory result.

SKIN GRAFTING BY MEANS OF FREEZING WITH ETHYL CHLORIDE

By GASTON TORRANCE, M.D., Birmingham, Alabana

A NUMBER of years ago, while resident physician in The Old Pennsylvania Hospital in Philadelphia, I devised the following method of skin grafting and published a report of some cases.

Since that time I have used the method in a number of cases and have found it quite satisfactory in small areas in which there has been considerable destruction of tissue, as in deep burns or ulcers; patients with painful leg ulcers exposing a nerve, have experienced immediate relief.

The thigh is shaved and cleaned with ether and alcohol; and an area on the top of the thigh about the size of a silver dollar is frozen and is cut out with a sharp razor just within the frozen area going well down into the fatty layer. The grafts are applied immediately to the granulation surface and when they become "thawed out" they will be found to be firmly glued to the granulation surface. They very rarely show a tendency to separate if the granulations are in good condition when the grafts are applied and if care is taken not to rub them off.

A dry dressing is applied and is changed every day if there is any discharge from the surrounding granulations.

The accompanying photograph shows four grafts that are firmly adherent and stand out above the granulation surfaces like normal healthy tissues.

Photograph taken two weeks after the application of skin grafts to leg ulcer while frozen.

MURPHY BUTTON RETAINED FOUR YEARS

Complicated by Ulcer at Site of Gastro-Enterostomy

By A. F. TYLER, B.Sc., M.D., Omaha, Nebraska

THE following case is of interest because of its rarity and because of the pathology which was demonstrable at the examination. Through the courtesy of F. J. Schleier, who referred the patient, I am able to give the following history:

The patient was operated upon 4 years previous to our examination for chronic ulcer of the duodenum. When the abdomen was opened it was found that there were massive adhesions involving the duodenum and the distal portion of the stomach, as well as the biliary passages. On this account it was impossible to do a posterior gastro-enterostomy. Instead of this, an anterior gastro-enterostomy was done by the usual technique, following which an entero-enterostomy between the duodenum and jejunum was made. This opening was secured by the use of a good sized Murphy button. Although the stool was watched for a number of weeks following the operation, the button was never recovered. Because of the fact that no symptoms were produced the patient had never given the matter any concern.

At the time of our examination, the patient had been suffering for one week with a return of burning pain in the epigastrium which he described as the same pain he had before his operation, accompanied by nausea and occasional vomiting.

Roentgen examination revealed at once the Murphy button which at first observation was in the loop of duodenum. At later observations, the button was found in the stomach (Fig. 1).

Filling the stomach with an opaque meal revealed the gastro-enterostomy opening functioning but at the site of this opening an area of induration was seen which was very tender to pressure over the abdominal wall. We concluded, therefore, that the patient was suffering from an acute ulcer at the gastro-enterostomy opening and that the presence of the Murphy button was not the causative factor.

An interesting sequel to the roentgen examination of the stomach was the fact that within a few days the pain disappeared and the patient was symptomatically well. The improvement was noted the following day, gradually increasing until all tenderness and pain had disappeared. It is our opinion that the large amount of barium, six or seven ounces, contained in the opaque meal followed by a course of bismuth subnitrate, was responsible for this therapeutic result.

A search of the literature of the past 6 years reveals only two reported cases of Murphy button remaining in the abdomen over a prolonged period. A. D. Bevan[1] reports the removal of a Murphy button from the stomach two and one half years after gastro-enterostomy for duodenal ulcer. A. Wettstein[2] reports three cases of ileus from retained Murphy button. One of these buttons was removed 45 days, another 7 weeks and the third over 4 years after use. Since his three cases occurred in a close series he thinks he probably had defective buttons. The buttons were lodged 25 and 35 cen-

[1] Surg. Clin., Chicago 1917, June.

[2] Cor.-bl. f. schweiz. Aertze, 1919 Mar. 29

Fig. 1. Roentgenogram of Murphy button in abdomen 4 years after operation. No symptoms were produced by its presence. At one observation it was in the loop of duodenum, at subsequent observations it was in the stomach. It could be pushed about at will with no discomfort to the patient. The patient came for examination because of burning pain and tenderness in the epigastrium. An ulcer was found at the gastro-enterostomy opening.

timeters above the valve of Bauhin and considerable force was required to dislodge them.

The combination of Murphy button and of ulcer at the gastro-enterostomy site is not reported in available literature. Frequent mention is made of ulcer following gastro-enterostomy. It has been found that these ulcers recur following the use of non-absorbable sutures so that the use of absorbable sutures in gastric surgery is thought advisable.

In the case referred to above where the Murphy button was found in the stomach following an anterior gastro-enterostomy and a duodenojejunostomy non-absorbable sutures had been used on the outside with absorbable sutures on the inside. It is possible that as time has passed some of these sutures ulcerated through into the lumen. Since the examination, the patient has been entirely free from distress following large doses of bismuth subnitrate.

AN AMPUTATION STUMP RETRACTOR[1]

By P. W. SWEET, M.D., Rochester, Minnesota
Fellow in Surgery, Mayo Foundation

FIGURES 1 and 2 illustrate the use of an amputation stump retractor designed for the purpose of keeping the soft tissues away from the saw while an extremity is being amputated, and of securing an instrument which can be quickly applied and at the same time used for holding the bone steady while it is being sawed. Every surgeon who has done an amputation of a large fleshy thigh or arm has been aggravated and delayed by threads from a three-tailed muslin retractor being caught in the teeth of the saw and often because of insufficient retraction of the muscle and other soft parts of the stump, the bone is left too long; thus another amputation has to be made or the chances taken of leaving a troublesome stump.

Two sizes of instrument which will fit any sized bone of arm, forearm, thigh or leg, are fashioned, although the larger size fills the need in almost all cases. Both of the sizes are heavy enough so that strong traction can be made on the tissues and at the same time the bone is stabilized for sawing.

Two other similar instruments for the same purpose have been found on the market; one of Scandinavian, the other of English make. The Scandinavian instrument is designed with a diaphragm similar to the iris diaphragm of a camera; it is complicated, difficult of application, and has fallen into disuse. The English instrument is fitted with a sliding part so that the bone is entirely enclosed.

Fig. 1.

Fig. 2.

[1]Presented for publication, November 14, 1919.

FACILITY IN CLOSURE OF THE PARAMIDIAN UPPER ABDOMINAL INCISION

By CHARLES A. PANNETT, M.D., F.R.C.S., London, England
Assistant Surgeon, Royal Free Hospital; Supernumerary Out-Patient Surgeon, St. Mary's Hospital

THE suture of the usual paramedian supra-umbilical incision for approaching the upper abdominal viscera, occasionally presents considerable difficulties. The transversales muscles go into spasm and widely drag apart the lips of the aperture in the posterior rectus sheath. The suture material passing through this sheath with its transversely running fibers, tends to cut out, the sheath edges become frayed, and closure is only obtained by taking a wide bite of the rectus muscle. The result of this procedure is that an irregular non-peritonealized area is left on the inner aspect of the abdominal wound which favors very decidedly the formation of adhesions to the scar.

The mechanism of the production of this muscle spasm must be kept to the fore in devising procedures for overcoming it. It is a reflex, the afferent impulses of which arise, partly in the abdominal viscera and partly in the abdominal wall. When the principle of anoci-association was first widely advocated, I was able to show experimentally in the cat,[1] that the muscles of the abdominal wall could be thrown into spasm by electrical stimulation, not only of the parietal peritoneum, but also of the contained viscera. In view of the measures which have been proposed to eliminate this muscular rigidity, it is necessary to insist that such afferent muscle-spasm producing impulses may originate in such organs as the stomach, gall-bladder, and duodenum. Indeed, the anæsthetist of experience insists that roughness of manipulation in the upper abdomen very materially increases his difficulty in arriving at the muscular relaxation required by the operator. Another factor in maintaining spasm is the excess of carbon dioxide in the blood, an excess very difficult to eliminate in certain individuals. This carbon dioxide increase has a central action.

The measures which have been employed hitherto for overcoming the difficulty of suture, have been, either the adoption of spinal anæsthesia, or the local infiltration of the abdominal wall. Of spinal anæsthesia there is this to be said, that though it is the best method of banishing muscle rigidity, it is not always expedient to use it, especially for operations in the upper abdomen. Of the local infiltration method it is to be remarked that, as applied by many surgeons, it is not founded upon known physiological facts and established experimental data, and this accounts for its ineffectiveness, which has led so many surgeons to discard it as a routine technique. It was directed that the layers of the abdominal wall should be infiltrated step by step with 0.25 per cent novocaine solution. The adverse critics of this recommendation have only to point out that it is impossible to open the abdominal cavity to one side of the middle line in a painless fashion by this method. Unless

[1] Brit. J. Surg., 1914, Oct.

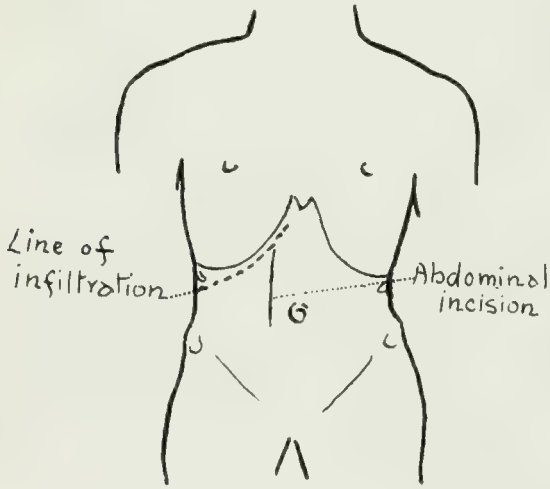

Fig. 1.

Fig. 2.

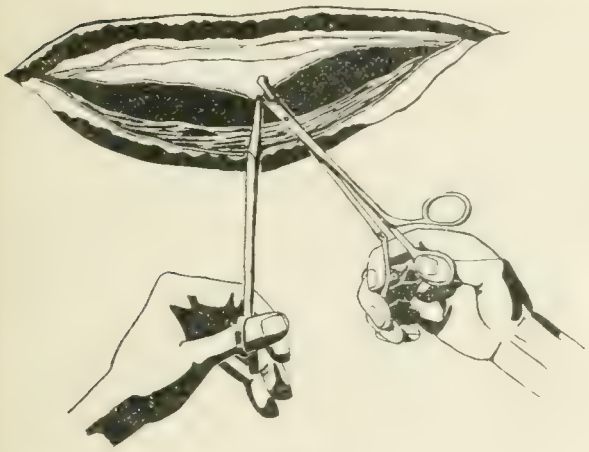

Fig. 3.

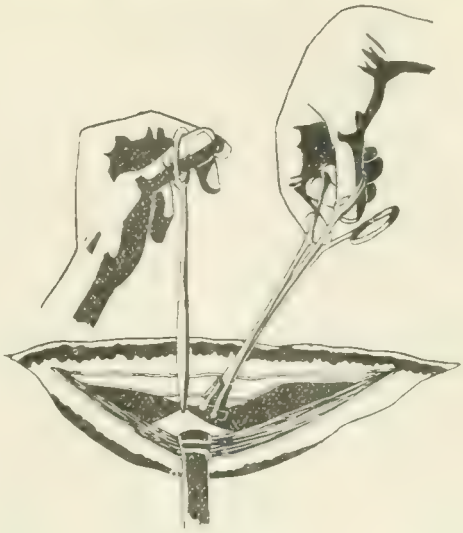

Fig. 4.

the strength of novocaine be increased to ½ per cent and adrenalin be added, and a sufficient time be allowed to elapse between the injection of the anæsthetic and the incision of the wall, anæsthesia is not obtained. Certain surgeons advocate the free infiltration of the rectus muscle and of the sensitive parietal peritoneum from its deep surface with ¼ per cent novocaine just before sewing up. It is not the rectus muscle which causes the wide separation of the lips of the deep rectus sheath; only one set of afferent impulses is blocked, and the method is obviously contra-indicated in the presence of sepsis, that is, in such cases for example, as a perforated gastric ulcer where ease and speed in suture are so advisable. If the use of novocaine to obtain relaxation is to be depended upon, it is better to attempt to block the efferent motor arc rather than the multiple afferent paths. This can be done by injecting a sufficient quantity of ½ per cent novocaine, to which has been added 2 to 3 drops of adrenalin (1:1000) per ounce, along a line parallel with the costal margin (see Fig. 1). If, as soon as the abdomen be opened, the left hand be inserted and brought in contact with the deep surface of the abdominal wall in this region, it will act as a guide in the injection of the anæsthetic solution from two or three skin punctures. Every layer of the abdominal wall can then be infiltrated and all motor impulses going to the muscles be effectively cut off. Since in the usual right rectus incision it is the right side of the sheath which retracts most (the left side being more anchored by the intact abdominal wall on that side), it is found very often only to be necessary to infiltrate below the right costal margin.

The simplest way, however, to facilitate suture under the trying conditions of muscle spasm is to use the pair of forceps depicted (Fig. 2). If the separated edges of the deep rectus sheath be seized with Spencer Wells forceps, it is always possible, with steady traction, to bring them together. If they can be held together in this position until a sufficient number of passages of the needle has been made to withstand the distraction strain, they will remain in position and the suture will not cut out. This can be done by the three-jawed forceps exhibited, and the manner of using them can be seen best from the diagrams (Fig. 3 and 4). By seizing the far edge of the sheath first, this, without any danger of tearing it with the rounded extremities of the blades, can be dragged toward the near retracted edge. The near edge can then be grasped in the other jaw, when the two margins will remain in contact for suture. Four such forceps are necessary for the ordinary sized wound, but six should be available.

The use of these forceps renders what is often a tedious time-consuming procedure, a comparatively rapid and easy one.

ENUCLEATION OF THE EYEBALL AND ITS SUBSTITUTE OPERATIONS

By JOHN E. WEEKS, M.D., F.A.C.S., New York, and ALLEN GREENWOOD, M.D., F.A.C.S., Boston

IN considering the operation best suited in any case where enucleation or a substitute operation is contemplated, the condition of the eye will determine within certain limits what operations are feasible. Thus, if there is an intra-ocular growth, if the globe is greatly shrunken, if the eye threatens to excite sympathetic inflammation in its fellow, the entire globe should be removed. If these conditions do not obtain, operation contemplating the retention of a portion of the globe may be performed.

There are many modifications in the performance of enucleation, but certain principles should govern the operation which, if observed, will produce as good results as may be obtained by the modification:

1. Retain all conjunctiva possible.

2. Dissect close to the sclera, removing as little extrabulbar tissue as possible.

3. When intra-ocular tumor is present remove at least 1 centimeter of the optic nerve next to the eyeball; otherwise, sever the optic nerve quite close to the eyeball.

4. In dividing the optic nerve, cut from the nasal side in order to avoid the possibility of perforating the os planum of the ethmoid.

Anæsthesia. General anæsthesia is preferable as a rule, but when certain conditions obtain, as defective heart action, advanced arteriosclerosis, extreme age, chronic bronchitis, etc., local anæsthesia is desirable. This may be obtained by instilling a few drops of a 4 per cent solution of cocaine into the conjunctival sac, and after 5 to 10 minutes injecting 10 to 20 minims of a sterile 1 per cent solution of cocaine, novocaine or alypin, to which a few drops of adrenalin chloride (1:1000) are added, 4 to 4.5 centimeters deep into the orbital tissues in the vicinity of the ciliary ganglion, entering the orbital tissue either through the conjunctiva near the external canthus or through the skin, about 1 centimeter to the outer side of the external canthus. In all of the cases operated on under local anæsthesia, some degree of pain is complained of.

The proper enucleation of the eyeball was performed first by Bonnet 1841 (1), the operation being based on his studies of Tenon's capsule, also known as Bonnet's capsule.

Briefly, the operation is as follows: The conjunctiva is seized by fixation or mouse-tooth forceps, about 3 millimeters from the margin of the cornea, and divided at the corneal margin. The incision is continued around the cornea and the anterior portion of Tenon's capsule separated from the sclera back to the insertion of the recti muscles. The tendon of the external or internal rectus, as may be more convenient, is lifted on a strabismus hook and divided so as to leave a very short stump (½ to 1 millimeter) attached to the sclera to afford a hold for the fixation forceps. All of the other recti muscles are lifted on the strabismus hook near the sclera and divided close to the sclera. The globe, if not too large, may now be luxated in front of the blades of the speculum which are partly closed to support it. The stump of the lateral rectus first divided is now seized with the fixation forceps, the globe slightly rotated outward, the enucleation scissors passed from the nasal side and the optic nerve divided. The eyeball is rotated outward, the remaining orbital tissues and the tendons of the oblique muscles divided close to the sclera and the eye removed. The margin of the divided conjunctiva and the very anterior margin of Tenon's capsule are now caught in a purse-string suture, and the opening closed by tying the suture rather loosely. Some operators omit the suture, but if this is done polypoid masses may develop at the site of the conjunctival opening.

The substitute operations are performed for the purpose of producing a cosmetic effect better than that obtained by simple enucleation. Many, if not all, of the substitute operations accomplish this result.

The substitute operations may be considered under two heads:

1. Those which consist in the removal of the entire globe, followed by the implantation of some substance into the cavity of Tenon's capsule either at once or some time later (delayed implantation).

2. Those in which the whole or some portion of the eyeball is retained (a) without implantation; (b) those in which some substance is implanted within the fibrous coat of the eye.

To the first belong the following operations:

1. Filling the cavity previously occupied by the eyeball with paraffin (Suker, 2; Ramsay, 3; Spratt, 4).

2. Turning in a piece of integument either from the lower lid (Maxwell, 5) or from the temple (Cross, 6). Inserting a glass or gold sphere (Frost, 7). Inserting the eye of a rabbit (Chibret, 8). Inserting a mass of fat (Barraquer, 9). Inserting a circular piece of skin and underlying fat from the deltoid region (Rollet, 10), etc. Wire balls, balls of silver, hollow rubber balls, balls of polished bone, balls of elder, pieces of costal cartilage, etc., have been used. It has so far been found that fat, glass and gold balls and cartilage produce the best results.

To the second group belongs opticociliary neurectomy (Boucheron, 11); anterior amputation with retention of a part of the contents of the globe (Critchett, 12; Lagrange, 13).

Evisceration. This includes the operation of Noyes (14). Freely incising the cornea and wiping out the contents of the globe; the operation of von Graefe (15) consisting in excising the cornea and ciliary zone and removing the contents of the globe; also the operations of Ahlstrom, de Lapersonne (16) and Nicati (17). Nicati's operation which is termed subenucleation consists in excising the posterior third of the eyeball, removing the contents of the globe, preserving the anterior two-thirds of the fibrous coat including the cornea. Gifford's (18), in which the entire sclera and cornea are retained, the contents of the globe being removed. Huizinga's (19), evisceroneurotomy consisting in removing the anterior portion of the fibrous coat, as in Mules' operation, but making the long diameters of the opening in the horizontal meridian, then excising a circular portion of the sclera at the posterior pole of the globe, including a section of the optic nerve and short ciliary nerves and ciliary vessels, and removing the contents of the globe. An artificial vitreous may or may not be inserted.

The insertion of an artificial vitreous. This includes Mules' (20) operation, in the performance of which glass or gold balls should be employed, of a size small enough to permit of closure of the scleral opening without any pressure whatever, and Barraquer's (9) modification of Mules' operation in which a mass of fat from the gluteal region is used instead of the metal or glass ball. Dimity (21) has devised a modification of Huizinga's operation, excising the cornea and ciliary zone and removing a disc of sclera, including a section of the optic nerve and short ciliary nerves at the posterior pole, and after removing the contents of the sclera thoroughly, inserting a gold ball, suturing the sclera over the ball. The conjunctiva and Tenon's capsule are not drawn entirely over the sutured sclera, leaving a small area to cicatrize in order not to compromise the conjunctival sacs, for the purpose of permitting greater movement of the prothesis.

Morax has recently been employing sheep or bovine cartilage for insertion into Tenon's capsule and into the sclera in place of glass or gold balls. He keeps the cartilage in formalin, 10 per cent, until wanted. It is then soaked in alcohol to remove the formalin, and later in sterile water to remove the alcohol, then cut to the right form and introduced aseptically. Excellent results are claimed from the use of this material.

Inspection of the cases presented, will convince one that a substitute operation should be performed whenever the condition of the eye to be removed will permit, if the individual is not too far advanced in years.

I am greatly indebted to Doctors Reese, Shine, and Key for their kindness in presenting cases.

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DISCUSSION BY ALLEN GREENWOOD

Technically speaking substitutes for enucleation mean some method of treating an eye, which should otherwise be enucleated, by which part or the whole of the globe may be retained.

Under the heading "Additions to Enucleation" will be grouped those methods which, after an eye has been enucleated, are used with the intention of improving the appearance of an artificial eye.

SUBSTITUTES FOR ENUCLEATION

Of the substitutes for enucleation evisceration is the one most commonly used and this operation is to be preferred to enucleation under the following conditions: first, in the presence of a panophthalmitis following a perforating wound of the eye or a perforating serpiginous ulcer; second, in the presence of orbital cellulitis when the eye itself is also involved in the suppurative process; third, in cases when the eyeball has been so torn to pieces that it would be difficult to do a simple enucleation, as seen so frequently following shell injury. The stump resulting from a well-performed evisceration is a very good one and allows for considerable movement of the artificial eye.

Another substitute for enucleation which formerly was frequently employed consists practically of an evisceration, with the addition thereto of a small glass ball sewed into the sclera (Mules' operation), thus retaining a portion of the eyeball with the muscles attached. This provides an excellent stump for the wearing of an artificial eye, and in this particular is better than a simple evisceration, but frequently the glass ball is extruded.

Still another substitute, very rarely used at the present time, is an opticociliary neurectomy, the object of which is to prevent recurrence of pain and still allow the eyeball to be retained.

ADDITIONS TO ENUCLEATION

Many surgeons are in the habit of performing a simple enucleation without regard to the cosmetic effect. This I feel is a mistake for it seems to me that there are two things always to be considered where the question arises as to the enucleation of an eye. First and foremost, is conservation of vision for the opposite eye and second, the preservation for the patient of the best appearance possible. It is perfectly possible for a general surgeon to enucleate an eye, but in the writer's experience the removal of such eyes is usually done with the removal of most of the contents of the orbit, leaving the patient with a very unsightly appearance. Some good ophthalmic surgeons are still doing simple enucleations without any attempt to suture muscles or in any way make efforts to improve the patient's appearance. I rarely have a patient needing an enucleation who is not desirous that the artificial eye shall look as near as possible like the other and this desideratum can never be obtained by the simple enucleation of the eyeball.

A great many additions have been brought out in recent years and the first and simplest was the suturing together of the recti muscles following an enucleation. This left a better stump than if the muscles were allowed to fall back but it was such a small stump that it allowed the upper lid to sink in, and the artificial eye always had a sunken appearance with only moderate movements.

In order to increase the size and consequent motility of the stump various substances were placed in Tenon's capsule within the cone of muscles with the idea of their retention. Following the use of the hollow glass spheres in Mules' operation surgeons began to use these same spheres in Tenon's capsule. It was soon found, however, that these small Mules' spheres were easily extruded or misplaced and still allowed the upper lid to sink in.

Some 20 years ago the author began to use larger glass spheres for this purpose and has constantly advocated their use ever since. A sphere smaller than 18 millimeters is practically never necessary and usually a 20-millimeter or sometimes a 22-millimeter sphere is implanted in Tenon's capsule. A 20-millimeter hollow glass sphere makes a stump large enough so that in subsequent years there is no sinking in of the upper lid, and this is surely the condition most to be desired. As the muscles are always fastened together in front of the glass sphere, good movement is always imparted to the artificial eye. It is essential to prevent extrusion of the glass globe that it be fastened carefully in Tenon's capsule before the muscles are fastened together. The conjunctiva should be sutured with sutures at right angles to the palpable fissure in order not to shorten the conjunctival space laterally. The writer has performed this operation nearly two hundred times in the past 20 years and in only one case has the glass sphere been extruded, thus proving that, with a large sphere, carefully placed as directed, there is no need of this accident. The cosmetic effect in all these opera-

tions has been most excellent, many patients being able to go about without anyone suspecting but what they had two good seeing eyes.

Various other materials have been used in place of the hollow glass spheres; fat taken from the abdomen, requiring a second operation on the patient, decalcified bone, paraffin, sponges, and other materials. The writer has had no experience with these substitutes for the glass globe but is of the opinion that probably in the future decalcified bone may be more commonly used.

Many surgeons use gold or metal spheres in place of the glass sphere, fearing that the latter may be broken. This accident the author has never seen and, while he occasionally uses a gold sphere, he has practically decided from his experience that the glass sphere answers all the requirements.

CORRESPONDENCE

TREATMENT OF EMPYEMA

To the Editor:—In a paper entitled "Empyema", which appeared in the January, 1920, number of SURGERY, GYNECOLOGY AND OBSTETRICS, Alexis Victor Moschcowitz makes the following statement:

"Putting theory aside, however, early thoracotomies are attended by a terrible mortality, as the statistics in our military camps during the epidemic of 1917 and 1918 woefully testified. Early operations were probably prompted by the enthusiasm of both internists and surgeons, who for the first time saw empyemata in large numbers develop under their very eye, and felt that early operation, which in other suppurative surgical affections is a great desideratum, would give similarly brilliant results. It was only when frightened by the formidable mortality that a halt was called on early operations, and the statistics improved. The patients died not only in large numbers but promptly after the operation. When we consider that these operations were done upon a patient who was at the same time sick unto death with an active pneumonia, it is not surprising that the mortality was so large."

The time to operate in a given case of empyema should be determined solely by an appreciation of the amount of damage the exudation in the pleural cavity is causing the individual. If the patient seems likely to perish because of an intense toxæmia, the major source of which is absorption from the pleural surfaces, it would seem to be wise to evacuate it without regard to the stage of the disease. If death appears imminent from the pressure exerted by a large collection, it certainly is perfectly proper to relieve that pressure at any stage of the disease.

Early operation in empyema, that is costatectomy, fell into disrepute largely because too much was expected of it. It is no panacea, but it certainly is not a dangerous procedure and of itself it does not kill or even produce any appreciable degree of shock if done under local anæsthesia.

The situation in my service was something like this: A soldier contracted pneumonia which would run a more or less stormy course. About the time the temperature reached normal there would be a sudden rise with aggravation of the other symptoms and the physical signs of fluid would appear. Aspiration would be done and repeated while he was on the medical service, until the fluid was macroscopic pus when he was sent to the surgical service. If he died while still on the medical service his death was recorded as due to pneumonia. But if he died ever so shortly after a rib resection his death was due to empyema.

This made the statistics of rib resection look bad. I submit, however, that no just conclusion can be reached without a knowledge of the number of fatalities in the same class of cases which were not subjected to rib resection, or thoracotomy.

In the very virulent infections where the exudation into the pleural sacs occurred early in the course of the disease, the advisability of some form of permanent drainage was a question much discussed by the members of our staff. The exudate in these cases consists of a bloody pus too heavy to run through an aspirating needle. Cultures show the hæmolytic streptococcus to be the predominating organism. There can be no doubt about its extreme toxicity.

If a simple thoracotomy is done on these patients most of them will die, and the operation will get the credit of contributing to the fatal termination, whereas if left alone to struggle against the toxins absorbed from a large absorbing surface, they will surely all die. The body has not had time to build a protecting wall against the absorption of this material. It certainly makes one review his reasons for the procedure to have a succession of fatalities,

and this was my experience, but I also have the comforting assurance that two lives were saved which would, in my judgment, have been lost had not an exit been provided for several hundred cubic centimeters of virulent pus. I have not seen a death in these cases which I thought was caused or contributed to by the operation. On the other hand, I have seen cases which were operated upon in spite of an obviously fatal prognosis, live much longer than was anticipated.

I have failed to appreciate the danger attributed to the artificial pneumothorax in these early cases. My experience is that the patients are immediately much more comfortable as soon as a large collection is withdrawn notwithstanding the fact that the fluid is replaced by air.

We freely admit "that statistics improved" after a halt was called on early operations in these cases, but we do not admit that fewer died from the affection. When one refuses to operate upon any but the late cases he allows a certain number of the acute cases to die that might have stood a chance with drainage.

As stated above the question should be decided by a consideration of the amount of damage the pleural effusion is doing in the individual case. We have seen comparatively large effusions of pus which were discovered accidentally and were the cause of very little distress. We have seen small effusions or purulent exudations which we thought at least were adding materially to the patient's toxæmia and lessening his chances for recovery and we have seen the fever drop and the symptoms improve at once on the removal of such an exudate.

There should be no hard and fast rule promulgated for the treatment of these cases but the decision as to whether to operate or not to operate should be arrived at after a study of each case.

BUDD VAN SWERINGEN, M.D.

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TOXIC EFFECT OF FIBROID TUMORS OF UTERUS

To the Editor:—In the December, 1919, number of SURGERY, GYNECOLOGY AND OBSTETRICS, there is an article by R. R. Huggins, of Pittsburgh, on the subject of toxic effect of fibroid tumors of the uterus.

I was very much interested in this article and have noted many of the points brought out. However, I am constrained to believe there are other changes than those noted by the author; namely, changes in the cerebrospinal nervous system. Having had two cases which were to me intensely interesting, and thinking other surgeons might have observed similar results, I would report them briefly.

CASE 1. Mrs. B. white, age 50, with fibroid tumor the size of a cocoanut, entered the hospital for operation. The history, both personal and family, was negative except for symptoms of fibroid and the patient had had free bleeding for some time. Physical examination showed a large fleshy woman somewhat anæmic but not pronouncedly so; pulse, blood pressure, and temperature, normal; no evidence of cardiac weakness; urine normal. Under gas-oxygen anæsthesia a supravaginal hysterectomy was done. There were no complications, but the tumor was difficult to dislodge. The operation progressed very satisfactorily until about the time the stump was being dealt with when she developed a most pronounced tonic convulsion which lasted for probably two minutes; respiration ceased; she became cyanotic and had every appearance of an ordinary puerpural or epileptic seizure.

After the convulsion passed the operation was finished and patient put to bed in good condition. She went on to complete recovery with no further complications. She gave no history of ever having had any convulsions or any symptoms of grave nervous disorder.

CASE 2. Mrs. H., white, age 36, married 5 years, no pregnancies. Personal and family history was negative. Physical examination showed a woman well nourished but very anæmic. She gave a history of profuse menorrhagia for several months past. Hæmoglobin was 50, pulse and blood pressure about normal, kidney function good, no œdema, no headache and no dyspnœa. A soft blowing murmur was heard at the base of the heart, apparently anæmic. Vaginal examination revealed a fibroid tumor the size of a large grape fruit. She was put to bed and forced feeding with iron tonics prescribed. She was instructed to report at the first appearance of the next period; we wished her to regain as much blood as possible. She improved rapidly, hæmoglobin increased to sixty; in fact, the patient seemed to be in perfect health.

At the first appearance of the hæmorrhage she was sent to hospital and prepared for operation. She was catheterized on the table, eight ounces normal colored urine being obtained. Gas-oxygen was used as anæsthetic, preceded by morphine ¼ grain, atropin 1/150 grains, one hour before operation.

The operation was very simple and easy; there was no hæmorrhage or shock. Just about the time the stump had been completed she suddenly ceased to breathe and the heart ceased beating. With the right hand pressed up against the diaphragm not the faintest quiver could be felt about the heart. Cardiac massage was practiced with the right hand pressing the heart from below and the left on chest wall. After quite a lapse of time the heart began to act and breathing was established, and color returned. However, artificial respiration was kept up for some 15 minutes after the heart resumed action.

The abdomen was closed, breathing and pulse became normal, and the patient was put to bed in apparently a very satisfactory condition. After being in bed for about 30 minutes she had a most violent convulsion and never regained consciousness, convulsions recurring about

every 30 minutes to 2 hours, and she died in about 36 hours after the operation.

A catheterized specimen of urine was examined after convulsions began and showed quite a little albumin but no casts. The flow of urine was free and sufficient in amount. No history of any previous convulsions.

I was and still am unable to account for the cause of the symptoms. We at first decided it might be due to impurities in the gas, but as two other patients had been anæsthetized from the same cylinder with no bad effects, we decided this could not have been the cause.

I wonder if it could be possible that there could have been set free in the circulation some toxic substance that caused the convulsions in these two cases or could it be possible that the anæsthetic used could have played any part, as I have never seen such symptoms in a case when ether was used as an anæsthetic. If any one else has had such experiences I would be glad to hear from them.

I have operated upon many cases of fibroids under both gas-oxygen and ether, but these are the only cases I have ever seen which have had tonic convulsions develop during or so shortly after an abdominal or pelvic operation. There is at least to my mind a suspicion of some tumor intoxication.

L. L. Sheldon, M.D.

Knoxville, Tenn.

IN MEMORIAM — EMMA B. CULBERTSON, A.M., M.D.

Emma B. Culbertson, a member of the staff of the New England Hospital for Women and Children since 1883, died at St. Petersburg, Florida, January 8, 1920. Dr. Culbertson was well known as one of the prominent Boston surgeons for many years, a member of the American College of Surgeons, the American Medical Association, the Massachusetts General Society, National Women's Medical Association, Women's City Club of Boston, and other organizations interested in all movements for the advancement of women.

Be It Resolved, That we, her colleagues at the New England Hospital for Women and Children, deplore her loss.

We shall miss the inspiration that her constant enthusiasm and untiring service has been to us in our daily work.

Emily F. Pope, M.D.

Secretary Medical Staff, New England Hospital for Women and Children.

Boston

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting, December 19, 1919, with Dr. Arthur H. Curtis, President, Presiding

OVARIAN CYST

Dr. Rudolph W. Holmes presented an ovarian cyst, removed in the early puerperium. The patient was 33 years of age; second child, the first being a boy born in 1915. She menstruated last September 15; life was felt January 12; labor due June 22. She was seen on April 15, when everything appeared normal. On April 25 contractions began and recurred at irregular intervals; on the 29th she went to the hospital for two days. She was quieted by means of bromide, and went home. Labor was uneventful and terminated at 3 a.m. on April 30 (?). The child presented, the cord advanced immediately, and the placenta was delivered by expression. Twelve or fourteen hours postpartum the patient began having discomfort to the right of the uterus. At 7 p.m. the pain became severe, and the interne discovered a mass to the right of the uterus, 2 or 3 inches below the fundus. Leucocyte count, 18,000. The patient was seen at 9 o'clock and the tumor was a finger or two above the uterus; the interne had seen her at intervals during the 2 hours and found the tumor enlarging from time to time. A little after 9 the leucocyte count was 22,000. About 11 o'clock the husband arrived at the hospital after being telephoned for. The abdomen was opened, and a considerable amount of blood escaped. An ovarian cyst was found to the right of the uterus pushing the uterus to the left. The apex of the tumor rested at the brim and not in it. There were three twists in the pedicle and tube. The tube was much congested, and when the abdomen was opened blood was still oozing from the fimbriated extremity. The tumor was free and easily lifted up. Forceps were applied and the mass cut away. The abdomen was closed after cleaning out such blood as could be reached. Convalescence was uneventful; the highest temperature was on the second day, 100.2° F., pulse never above 85.

The interesting feature in this case is that a tumor of this size could lie behind the uterus during the months of pregnancy and not be noted until after delivery. Whether the tumor developed during pregnancy or antedated pregnancy is not known. It did not go into the pelvis or produce any abnormality in the birth of the baby and recovery was prompt. Probably one of the most fruitful causes of death from ovarian tumors with a twisted pedicle is that there is commonly a long interval between the first symptom and the time relief comes. When cysts are removed before gangrene occurs the chances are good. I have had four similar cases, two in pregnancy and two otherwise, and one that refused operation. In the two cases in pregnancy the pregnancy continued without disturbance.

DISCUSSION

Dr. Emil Ries: This very interesting case arouses my curiosity in three respects: first the medico-legal aspect. The doctor says he waited for the husband to come and give his consent. I do not know whether it is generally known that a husband can neither give nor withhold consent if the wife is in her right mind.

The second point is in regard to the torsion of the ovarian tumor. When an ovarian tumor in its natural growth comes out of the pelvis and grows from the true pelvis into the abdominal cavity, it usually falls forward, and that is the beginning of torsion. Thence torsion continues until the circulation is obstructed. Of course there are exceptions to this natural torsion of the ovarian tumor. I would like to know if torsion in this case was in the usual direction. It is conceivable that in the course of emptying the uterus in labor a torsion of an ovarian tumor may be produced which would be different from that ordinarily found.

The third point is in regard to the increase in the leucocyte count. An ovarian tumor that is undergoing twisting is a grave menace; in the presence of the enormous hæmorrhage the leucocytosis simply indicated the presence of anæmia. I would like to learn whether there was a decided change in the red count, which would explain the leucocyte count. It was not stated whether a differential count was made.

Dr. Arthur H. Curtis: I would like to have Dr. Holmes tell us whether the Credé or other abdominal massage was used, and whether the patient had any appreciable fever.

Dr. Rudolph W. Holmes: I know what the law is on the question of consent; the wife alone may give consent so long as she is mentally competent; the husband alone or a child under sixteen has nothing to say. But still, in the period of getting ready, the wife wanted her husband's consent. In a case of hæmorrhage I would not wait.

As I remember, the pedicle twisted from right

to left. Probably it was twisted beforehand; so commonly the twist is there with an ovarian pedicle. It was probably this process that caused the dry delivery and immediately after increased the torsion and obstructed the circulation. The patient went for several hours following delivery without discomfort. At 7 o'clock agonizing pain began and continued until she was relieved. In the hurry I could not get a record of the blood count and I think a differential count was not taken. The leucocyte count was taken as a matter of form, but no red blood count was made. She did not have an enormous amount of blood in the abdomen, but blood was evident; there may have been a couple of ounces altogether. There was no undue bleeding at birth, and the bleeding that comes with a normal puerperium had not yet manifested itself.

She had no temperature at all except on the second day, when it was 100.2° F., with a pulse of 80.

IMPROVED FORCEPS FOR REMOVING FOREIGN BODIES FROM BLADDER

Dr. Channing W. Barrett: I wish to present a new instrument that may be of help to some operators. It is to be used in place of the Kelly forceps to remove foreign bodies from the bladder. It occurred to me that a forceps of this type, guided by a cystoscope, the two introduced side by side, could easily remove a foreign body, and I have found that it works very nicely. I know of no instrument that would give more of a grasp to a foreign body, as for instance a hairpin. I have had no difficulty in using the forceps and cystoscope side by side in the female urethra. I insert the forceps first and then the cystoscope, and after grasping the foreign body remove the cystoscope, leaving more space through which to remove the foreign body.

ABDOMINAL SURGERY IN THE CASUALTY CLEARING STATION AND EVACUATION HOSPITAL

Dr. William Thompson read a paper on war surgery of the abdomen. (See p. 398.)

DISCUSSION

Dr. George de Tarnowsky: The paper was extremely interesting. I know what a large experience Dr. Thompson has had in France, first with the British and later with our forces. The part that interested me most was the question of what should be done with the untransportable case. We must recognize the fact that the American Army entered the War 6 or 9 months before it was prepared, and when we had to go in line and do our bit to end the War in 1918, we were handicapped. We lacked many things; among them front line equipment. We had no method of taking care of our cases where they should have been taken care of—as near the front line as possible—and the result was that many of the wounded men reached the hospitals long after the wound had been received; some already moribund. The French had begun to increase their auto transports, but I must give credit to the Italians for having the best of all. They had large trucks, six, eight or ten, with collapsible walls, that could be run up into the battlefield and be ready to operate within one and a half hours. I was fortunate enough after the armistice to be put in charge of one of these ambulances or *auto-chirs*. The Italians had seven in line at the time of their last offensive. Their final report showed a total of 16,500 severe and untransportable cases operated upon by these transport units. Bastianelli, of Rome, told me that of these they felt positive that at least 8,000 had been saved by them. Not only were these ambulances able to go close to the Front, but the best surgeons possible were sent in them. If the war had lasted until 1919, we probably would have had similar equipment. As for the lack of surgical teams, that was well known. I had just the same experience as Dr. Thompson had; I would telephone Headquarters for surgical teams and they would appear two, three, or four weeks later when we had no use for them. When the offensive occurred and the Germans were in Chateau Thierry we lacked everything. I did not even have my operating room up. In the field next to me was an operating team awaiting orders. For 5 days I tried in every possible way to have that team and field hospital assigned to me. I could not do it. Finally the Commanding Officer came over himself and we put up his little operating room and did our first operating in this little room, which I could not get assigned to me. That was our experience throughout the war. It seems impossible to get the Q.H.D. to operate rapidly. Regarding the movement of every surgical team as it landed in France, in 1918 I received an entire Hospital Unit as part of my staff. They had just landed in England and were assigned to me. They were excellent surgeons, all of them, but they entered the hospital with civilian ideals, taking forty-five minutes on a surgical intervention. With a great number of cases there we could not do that and we had to educate the surgeons not to pay any attention to the finer details. We had to evacuate our cases and make room for more, evacuating four or five hundred who could reach some of the base hospitals. The intervention must be extremely rapid, doing the important things and not spending a minute on useless, finer details.

There are lots of other points to talk about and it is hard to know where to begin and where to end. I enjoyed the paper very much and think we owe Major Thompson a vote of thanks for his excellent exposé.

Dr. Channing W. Barrett: Many of the surgeons who remained here in the United States undoubtedly had excellent experience in surgical work that was more like that of civilian life. Those of us who went to France so very early and stayed

late saw much surgery that has no similarity to private practice. I think those of us who are here tonight will say that the cases of abdominal injury, gunshot wounds, should all have an exploratory laparotomy, or nearly all. It did not take long over there to find that every patient who had a gunshot wound had better chances if operative procedures were instituted. The reason has been recounted by Dr. Thompson. We were not prepared for surgery, just as we were not prepared for many other things. At the Battle of Chalon the French had a hospital that was complete in every detail. They told us in March that at that place we would need an evacuation hospital. The battle began on a certain Monday. Our evacuation hospital arrived there from the States, on that ground in a wheat field, with tents, with everything to be made, six days before the battle commenced, and every man in connection with that work was new to army work except the Commanding Officer, who was a regular army man but who was very much unused to things in France. You can imagine the kind of organization. Before the operating tent was finished and with equipment very much lacking, they were digging trenches to put in pipes to run the water in. The battle started and the men began to come in at 6 o'clock in the morning. It was 11 o'clock before a man was put on the table. Six hundred came in that day and, contrary to the belief among some that only those who are able to go back very soon into line were given first aid, the worst cases were selected for the first operations. They were fairly well cleaned up the first day, and the next day the ones that had been left for the second day were worse than the ones that were operated upon the first day, and the ones that were quite trivial when they came in were worse on Wednesday than the worst cases on Monday. A great many difficulties of that kind were encountered. There was lack of experience, lack of equipment, men sent over as surgeons who received their appointment through politics and never did any surgery. There were men in command of teams with majorities who had had nowhere near the experience of the lieutenant under him. When they were coming in that way, more than the surgeons could get at even by operating 12, 24 or 36 hours, stopping only for nourishment—sometimes not nourishment but something that we swallowed, and sometimes good food, but not in those localities—you can see that we had our own troubles. When it made a great deal of difference whether these men went over from one day to another, it will be seen that a team must work at high power to care for as many cases as possible to save life. A team consisted of an operating surgeon, two assistants, usually two lieutenants, two nurses, and two orderlies. If they had the operating-room space and the tables they cared for a patient about every 10 minutes and that is somewhere near the degree of speed that must be attained to accomplish very much under these conditions. If this speed was not attained there were not sufficient teams to do justice to those who were waiting. When enough men came so that we could work in shifts, we worked in twelve-hour shifts, but that was too long for a team to work. It would be better to work in eight-hour shifts, that is long enough to get the best work out of a team. When you are working to get a man off the table every 10 minutes you will see that with a laparotomy coming along that, with his other injuries, is going to take an hour of time, it will not be justice to the other men waiting unless the patient on the table stands a fair chance of living. If the patient on the table were the only patient to deal with and you approached that laparotomy with a good night's rest behind you and there was nothing else waiting, the patient would stand a better chance of recovery, but as you approach that operation after having worked until you have seen all the surgery that you care to see, and find it is a procedure that is going to take an hour of time, the patient will not stand much chance of recovery, and at the same time some other man is put off until the chance to save his arms or legs, or his life is gone. So there is a question as to how much laparotomy work can be done. And yet the tendency is for civil surgeons going into army work to see every man get well. It is one thing to operate on gunshot wounds in our hospitals here where they come for only a few blocks and you see them immediately afterward, and another thing where they have been lying for hours on the battle field, losing a great deal of blood, and they have been picked up and taken from one place to another and finally arrive at a place where they can be operated on. It would be a good deal like having a man injured at Gary and brought in here during one of the worst snow storms we have ever had. The men might come from only five miles back of the lines about five hours after the injury, or they might come twenty miles twenty hours after the injury. It is more important to get things up to the line that are needed there than to get things back to us; so there was delay and delay.

I am glad to hear this paper, especially so as I visited Doctor Thompson's habitat. I remember one Sunday going over to his Division to visit some men. I did not know that Doctor Thompson was there when I started out on one of the most hellish automobile roads I ever saw. It was full of shell holes, dead horses, dead men, and a most awful odor. We stopped at a shell hole and got an odor which proved that the shell hole had been used as a burying ground for some soldier. We were on our way to Reddy farm and when we got there found Doctor Thompson and another man from Detroit ensconced there to take care of injured men who could not be taken elsewhere. I did not find Doctor Thompson at home—he had gone out in "No Man's Land." Not far away over a hill a little ways was the grave of Quentin Roosevelt. The shells were exploding then at a very short distance. These conditions are not favorable to laparotomy work and yet that is the only place that

laparotomy work can be done with any chance of giving the man a chance to live. He cannot ride to the evacuation hospital with an abdominal injury and stand much of a chance to live, and so you are between the devil and the deep sea to get close enough to give the man any chance to recover and yet have conditions that will give him any chance to recover. These conditions are determined by having a good, experienced operator there. That locality was fortunate in having such a man as Dr. Thompson; his type of man was not in that territory very much. We should have good facilities for reaching the place, and sufficient quiet from the front line so that the laparotomy patient is not in constant fear. He may have been very brave at the front, but after a laparotomy he is afraid and should be a long way back to recover, but the work should be done at the front. Ideal conditions are not frequent enough to make laparotomy work attractive at the front.

Dr. William M. Thompson (closing): I wish to thank you for your interest, Dr. Tarnowsky, and my good friend Dr. Barrett, I thank you both for your remarks. They only serve further to emphasize all that I have been trying to bring out. We were not prepared and the next time we will not be ready unless we do differently than we have in any of our wars.

CRITERIA OF PHYSIOLOGICAL FUNCTION OF THE FALLOPIAN TUBES

Dr. Emil Ries: Sterility of the female is very hard to explain. The female sexual tract is the most poorly constructed structure with which we have to deal. From the slight tearing of the cervix during the passage of the child to the very severe hæmorrhage which may kill the mother, the whole sexual life of woman is a continual series of narrow escapes between life and death. We have never been able to understand why woman menstruates; she has lived before she menstruated and after she has menstruated; she can have children while not menstruating — apparently she can perform all her physical duties without menstruating.

As to the cause of sterility, there are a few apparently evident causes which should be very hopeful fields for our therapeutic efforts. Certain causes of sterility are evident and apparent to the most superficial glance. I refer to those obstructions of the tube which are visible to the naked eye. The tubes are usually closed at the abdominal end, and are closed potentially or histologically. The tube can be closed potentially by simple agglutination at the end of the tube, which can be opened by pushing against the end of the tube and allowing the occlusion to come out through the fimbriated end. But that is not the only way in which a tube may be occluded. A tube can be occluded, rarely histologically, at the uterine end. Of the thousands that I have examined in my life, I have found just one tube which presented a complete occlusion of the tube at the uterine end. There are pathological occlusions which occur at the uterine end. Such occlusions present an absolute obstacle to conception. When there is a hydrosalpinx or a pyosalpinx, or any disease of the tube that is palpable, our diagnosis will center upon this obstruction. But many times tubes are occluded at the end and have not filled up. How can we diagnose such conditions? It would be well to be able to determine without opening the abdomen, whether the tube is closed or not. I will mention sounding which has been attempted through the uterus with the aid of the cystoscope, or by the method of touch, but we have never heard of any success following such efforts. If you remember the lumen you will readily see why it is so difficult to pass a sound.

There appeared a communication by Cary and another by Ruben in the *American Journal of Obstetrics*, and another in the journal of Surgery, Gynecology and Obstetrics, advising the use of collargol in the uterus under some pressure so as to make the collargol enter the tube, with subsequent X-ray examination of the patient. That seemed rational. I have thought it was worth investigating and I have carried out this procedure on three patients. The temperature chart of the first patient shows a rise in temperature. The chart shows vomiting and nausea and that she had bowel movements regularly. In the course of two weeks the patient recovered. During that time pelvic examinations were made at one week intervals and at the end of one week we felt a hard mass in the cul-de-sac, which was not ruptured. At the end of two weeks the mass was gone and there remained nothing but a slight tenderness of the ligament. The uterus was the same as before. The patient left the hospital and has remained well, and has not become pregnant. The other two cases were much the same. The three were perfectly clean women; all three were prepared as carefully as for any abdominal operation and the syringe was cleaned with all precautions. Nevertheless, these patients developed acute peritonitic symptoms. I have, therefore, discarded this procedure for fear I will occlude an open tube rather than open one that was occluded before.

Are there any other methods by which we could determine the permeability of a tube before operating? I know of no other way. One method suggested itself. Inject into the uterus without force some Chinese ink, and close the tube temporarily with the forceps. If the tube is open the ink will have to go into the abdomen. A few hours later if we make a small puncture and withdraw some fluid and it contains ink we will know the tube is open. I have not had the courage to do anything more since this last experiment.

If we cannot make the diagnosis beforehand, are we any better off with the abdomen open? When the abdomen is open and we see a fimbriated end, do we know that the tube is permeable? We do not. It may have an occlusion at the other end which we

cannot diagnose. Other ways of diagnosing that condition I do not know, so that in the face of the patulous tube we do not know whether that tube will perform the function of carrying spermatozoa. If the tube is permanently closed one would think that if the closure is opened the tube should do its work if the epithelium of the tube is at all normal. What is the epithelium in hydrosalpinx? After the fluid has escaped you can see that tube fill itself up, so you would expect it to functionate again.

Two years ago I operated for hydrosalpinx in a young woman who was anxious to have children. I removed the abdominal ends of the tubes and sutured them in the proper way and examined the other ends. We had first examined the woman's husband and knew that he had spermatozoa but the woman has not conceived in two years.

In a pyosalpinx, how do we know that the tubes can take up normal function? With the microscope perfectly good epithelium is found. Perhaps some of the epithelium has become lacerated and there are septa across the tube, and yet that tube should be perfectly able to recover and return to normal function. In a review of the results in some forty-odd cases, Bullock, of New York, reports three successful cases. He first operated years ago in cases where pus was present but the tube not closed. The operator cleaned the tube and the woman afterward became pregnant. If a tube contains pus, I think we should fear leaving such a tube, for we do not know what it contains. Suppose we make a smear during the operation and it is negative; on culture it may be found positive. We have not time to wait for a culture while operating. If the culture is positive and we find the gonococcus, how many surgeons would be willing to leave the tube? If I found the staphylococcus I would not know what to do, but if the streptococcus I would not be willing to leave it. The pathological examination would not help us much. Have we any criteria in such a case? The histological examination shows us only that a pyosalpinx is something that can be overcome and later permit a return to the normal. I have been examining my specimens and with the exception of one or two I do not believe there is one in my collection of hundreds where the condition of the tube would prohibit absolutely the return of that tube to normal. We find pus in the lumen but ordinarily find nothing to prevent its return to normal.

Have we any criteria in the course of an operation as to what to do with such a tube? That sounds like a pretty negative result of the examination of the question. We all feel safe with a hydrosalpinx. We would feel safe to leave it, but with a pyosalpinx I think most of us would hesitate to leave the tube. If it is a hydrosalpinx, how about it—do any of them ever allow conception afterward? I have followed up about twenty cases operated upon 12 years ago; of these twenty, three became pregnant and that is a pretty good percentage. One has had three beautiful children. Two have had nothing but abortions, but the three children are certainly worth all the operating on the other nineteen, because the operation is a perfectly harmless one and it is justifiable in hydrosalpinx. If there is a nodular condition of the uterine end, of course it is possible to carry out the operation Dr. Watkins advocated several years ago and stitch the tube in as far as may be necessary and unite it through the tube. This is a very simple operation which I have carried out in four cases, but none of them ever became pregnant. The anastomosis is a harmless operation and can do no damage.

All the women that I have seen with a hydrosalpinx acquired it from the puerperal infection. I have never seen a woman with a gonorrhœal pus tube become pregnant. Although it is claimed that in a gonorrhœal pus tube the plasma cells are present in good numbers, that should not interfere with return to normal for many of the other tubes.

Can anyone give us hope of bringing that tube to normal? I have found the question very difficult and hope you gentlemen will have better success in solving the problem than I have had.

DISCUSSION

Dr. T. J. Watkins: In the case referred to by Dr. Ries, the case of the anastomosis, the patient had a pyosalpinx on the other side. She wrote me that she was three months pregnant and had aborted. I am not absolutely certain as to whether she was pregnant or not, as I have never been able to confirm that.

The question as to whether the tubes are connected very often occurs to one in an attempt to treat sterility. We can make an incision through the fornix, something that can be done quickly, with very little traumatism and which will allow one to determine the condition of the tubes macroscopically. Especially can one determine whether the abdominal ends are open or not. Whether to open the abdomen to determine the condition of the tubes or not is decided by the condition of the patient and the history. If the case is a puerperal infection, then the fornix is much better. If it is a gonorrhœal infection one is hardly justified in doing this, or if the patient has had suppurative appendicitis I would subject that patient to the exploratory incision. One generally hesitates to subject a patient to much exploratory surgery if the husband gives much history of gonorrhœa. In one case a man whom I knew very well had had a number of attacks for a number of years. He had a double orchitis and a stricture which required urethrotomy. He asked me about being married. I advised him not to, but he got married and his wife had three children in five years. The wife never gave any sign of gonorrhœal infection except that she always had a flare-up of temperature during recovery.

We had to operate in two cases and saw the tubes entirely recovered from gonorrhœa where this was proved by abdominal section.

One was a case of a woman who had a very acute gonorrhœal peritonitis with an accompanying exudate that extended half way to the umbilicus. The husband had had acute gonorrhœa. This woman was extremely ill. Some five or six years later I operated for a large retrodisplaced uterus and, very much to my amazement, both tubes were absolutely normal so far as macroscopical examination was concerned. There were a few adhesions about the ovaries. The other case was that of a young girl whom I treated for acute gonorrhœa. She had an attack of salpingitis. She was not operated upon and, fortunately, recovered entirely. She had another attack of pelvic peritonitis and when she recovered I did an abdominal section and found both tubes were entirely normal. There were a few adhesions about the ovaries. I did not remove the tubes but following that she had an acute attack of peritonitis, and we concluded that it would be necessary to remove them. The abdomen was opened the second time and while the patient's tubes looked entirely normal we did not have the courage to leave them but removed them both and she has had no more pelvic peritonitis.

Dr. Channing W. Barrett: In relation to Dr. Ries' remarks about the collargol and the reaction from it, I might mention that it was the practice in one of the large clinics to inject the uterus with Beck's paste and if the paste was found in the abdomen when it was opened, it was certain that the tube was patulous and that it was safe to leave them. I have never had such success out of efforts at conservative work on closed tubes that encourages me to continue with such work. I have seen numerous instances where plastic work has been undertaken and the tube has rapidly developed a much worse condition.

Dr. N. Sproat Heaney: In looking at Dr. Ries' X-ray plates it occurred to me that perhaps one of the tubes is abnormally distended with collargol. I think Dr. Dickinson distended the tubes with collargol and took pictures. I saw several of his pictures but none of them had the appearance of this one. However, that would not account for the three patients having the rise in temperature. It did occur to me, though, that instead of taking on three cases it might be well to go back to the first and see whether then the tubes were occluded.

Dr. Mark T. Goldstine: Dr. Ries' remarks concerning the female genital organs were a shock to me. I am humble enough to think pretty well of Nature and Nature has treated me pretty well in medicine. If it were not for Nature I expect my mortality rate would be much higher. As regards the injuries to the female organs during childbirth, I think we might blame a good deal of that on the men. A great many women come to me first because they are forced to do so by their husbands, who are anxious to have offspring. If the wife does not become pregnant he makes a great "to-do" about it. Where Nature has lost the pattern and a girl is born without a vagina or tubes, the surgeon who makes an artificial vagina does not come anywhere near as good a result as Nature has in the first place, especially in bringing an intestine down and using it for a vaginal canal.

Dr. Rudolph W. Holmes: I frequently treat women who are sterile. They come because they have heard that operations may be done to overcome that condition. I always tell them to send the husband to me first so we can examine him before we operate. He never comes and she never comes back. Most men are willing to blame the wives, but they are not willing to be examined themselves. I am convinced that most of the sterility in families is due to the men.

Dr. Cary Culbertson: I think the great sterility in the patients who have a history of one attack, or repeated attacks of peritonitis is of great interest and that this has a real bearing on the production of children after the first attack, or becoming pregnant at least. The great proportion of our patients who come in with a pelvic mass, meaning bilateral salpingitis, give a history of never having been pregnant or of not having been pregnant subsequent to the first attack. That means, of course, in all probability, that the tubes are destroyed or put out of function as a result of that inflammatory reaction. Whether that causes hydrosalpinx or pyosalpinx we cannot tell until we see the tubes. If by operation or any other form of treatment we can cause a few of these tubes to functionate, why do not more of them become spontaneously cured? Why do we not have more pregnancies after attacks of acute peritonitis. I believe that gonorrhœal infection pure and simple is a relatively mild infection, and if there is no secondary infection the tubes may heal up. Of course, they may heal, but the patient is usually able to combat gonorrhœal infection. I think this explains the cases Dr. Watkins mentioned—the tubes have never become secondarily infected. In the majority of pus tubes that are not sterile we practically always see secondary infection, often colon bacillus infection. While it is true that they do show normal epithelium in parts of the tube, they do not show normal epithelium throughout the entire lumen, and the development of histological constriction or stenosis of the tube is usual close to the uterus in the narrow portion of the tube, or in the interstitial portion of the tube. But it seems to me that if we can succeed by operation in restoring to function a certain number of these tubes, more should spontaneously return to function than ordinarily do.

Dr. Theodore J. Doederlein: I have listened to Dr. Holmes' remark and it occurred to me that yesterday an attorney whispered to me not to mention that he had double mumps, as the patient was anxious to have children. So I think we should always examine the husband. Dr. Ries' remarks were so complete and he is so thorough that it is hard to discuss his paper. We have the puerperal infection which is a puerperal infection alone, and then of course we have the tubercular and syphilitic, which are very

rare primarily, but I hold that the gonorrhœal invasion of the genital tract is a destructive invasion. It is an ascending invasion of the mucous membrane and it leaves destruction behind. And these cases are the ones that frequently marry, and have one child. After the one child the woman is sterile. Why? Because after the congestion due to the confinement the old infection flares up and does the work that was not accomplished at the first invasion. So I believe that the infections *par excellence* are the gonorrhœal infections. On the other hand, in the puerperal infections we may have temperatures of 103 or 104° F. and have another pregnancy, and so on, until a woman dies from a flare-up of the infection.

I remember a case of a woman with a puerperal infection after a premature birth. She had pain at 4 weeks, not a parametritis. I had her in the hospital for 7 weeks and she was then all right but did not conceive. After a year she came to me more or less invalided. Perhaps I would not do it now, but I opened the pelvis and as the right side seemed the worst I left the left tube and ovary and removed the right. This was not a gonorrhœal infection but a streptococcic infection, which was present in the tube and possibly in the ovary. The woman promptly conceived and had a fine boy. I was telephoned for and upon examination found a large mass in the left side 5 days after confinement. She had a high temperature and died from general peritonitis.

I always take into consideration the wishes of the people when I operate, whether I should leave an obviously infected tube or not. It is a risk, but I tell the people about it.

Dr. Charles S. Bacon: Dr. Ries is speaking primarily of the criteria of the tube in the whole question of sterility, and I understand he is considering the function of the tube chiefly with the passage of ova and sperm, and if that does not occur the tube is not functioning properly. He has not mentioned the obstacles that are involved in the closure of the passage below the tube, or the failure of ovulation. Of course, it might easily happen that a tube will functionate and still there may be no fertility because ovulation does not occur, or there is an obstacle below preventing the passage of the ova upward. I should think it would be necessary in a full discussion of the subject to make the differential diagnosis of the location of the obstacle. I suppose we have seen, all of us, cases of sterility for some length of time from gonorrhœal infection, which has afterward disappeared. The point I particularly wish to emphasize is the question that the criteria of tube function is not entirely that of fertility. I would also like to suggest the possibility of any other tubal function beside that of offering passage for the spermatozoa. The very complicated arrangement of the tube would seem to be unnecessary for this simple passageway. Of course we know that the tube plays a part in the secretions. The amount of secretion is probably not altogether negligible and perhaps we may find eventually, when the tube is better understood, that it goes a little further.

Dr. Ries (closing): I limited the topic of my paper to criteria of the physiological function, and I omitted to state specifically what Dr. Bacon kindly supplied. What is the function? So far as we know, nothing but the duct for the ova. The tube does not menstruate. We know of no physiological function of the tube. When the ova becomes settled in the tube we consider that pathological and not physiological. I have left out all the other causes of sterility.

So far as the histology of the tube is concerned, I wish to take issue with the speaker who mentioned the structure of the tube. The structure of the tube is apparent. If you take it and examine it microscopically you find it is not a structure; it is lined with perfectly good epithelium and even the worst pus tubes have the best epithelium at the narrowest part of the tube. Cary mentioned in his paper that the largest part of the tube gives the largest shadow on the X-ray picture, as Dr. Heaney said.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis

THERE is in recent writings a certain gloom over the fate of gynecology lest it be absorbed by general surgery. Those who advocate such a process, should read Sturmdorf's book on *Gynoplastic Technology*[1] and those who are opposed to such an amalgamation will take heart from its perusal. For by its mere existence, this book is a sort of reassurance. A monograph of 334 pages on the dynamics of the female pelvis and its practical application to operative procedures is necessarily based upon that close study and concentrated thought which go hand in hand only with specialistic attention. Nor is such a book superfluous at this time. The methods of plastic restoration of the injured birth canal which have been handed down to us by the fathers of gynecology, no longer correspond in all respects to the advancement of our conceptions regarding the physiology and pathology of the pelvis; and it is commendable that the changes be presented to us in a comprehensive form. It may be said at the outset that the author has fully attained his object. His intimate knowledge of the subject is evident throughout the book and manifests itself most happily in the chapter on vesicovaginal fistula. The brief historical introduction to this chapter is splendidly done. Only the milestones are mentioned, those that represent truly new principles in the development of the operation. The author's own contributions to the plastic surgery of the birth canal are set forth clearly and are accompanied by instructive illustrations. Among these contributions, his method of tracheloplasty deserves particular attention. It is sound theoretically and easy of execution, as the reviewer can affirm from personal experience. It accomplishes its immediate purpose in a startling manner and avoids the unpleasant sequelæ which we so frequently observe after the old methods. In this as well as in all other operative procedures the instructions given are quite explicit and leave no point in doubt. A warning against making record time seems especially opportune: "Anything like an attempt at speed in plastic work denotes the self-consciousness of the operator rather than his actual skill in this special branch of surgery." A friendly criticism shall not be suppressed. The author devotes a separate chapter to sacral anæsthesia (to the exclusion of all other methods) and goes to some length in describing the technique, only to condemn the procedure in the end. Why not omit this whole chapter?

The scope of the book is wider than its title indicates. In particular, the discussion of the cervical mucosa and the significance of endocervicitis is most valuable. The author stands here abreast of the most advanced conceptions. The cervical mucosa is much more susceptible to infection than the endometrium and may aptly be termed the tonsil of the uterus. Infection travels upward through lymph channels and by producing a myometrial lymphangitis may cause menorrhagia and dysmenorrhœa. The cervical sphincter is an anatomical myth. The sterility of women with "conical cervix," "cervical flexion," or "pin-hole os," is *never* due to the cervical malformation as such, but to an existing endocervicitis.

These few quotations must suffice to hint at the interest in store for the reader and to indicate that the book deserves a warm reception from the profession.

IN his *Atlas of Operative Gynæcology*[2] Hirst has erected a monument to himself and to American gynecology. It is an unusual work—unusual both as to its exterior and its contents. It represents a record of the life work of a man with an exceptionally wide experience. The introductory chapter on equipment and preparation for gynecological operations contains the design of the new operating pavilion in which the author carries on his teaching. The remainder of the book is devoted to the technique of operations, and the author confines himself strictly to the conditions peculiar to women, leaving the operations common to both sexes to the general surgeon who is more competent to deal with them. The instruction given is chiefly by means of 164 large plates and 46 figures, and the accompanying text has been condensed so as not to detract from the pictorial character of the work. Even in these days when we have become somewhat spoiled by excellent pictures, the illustrations in the *Atlas* are remarkable as to their size, their clearness and accuracy, and anyone with previous operative experience who wishes to adopt Hirst's technique, will find it an easy matter to carry out the steps of the procedures advocated. The author hopes that

[1] Gynoplastic Technology. By Arnold Sturmdorf, M.D. Philadelphia. F. A. Davis Company, 1910.

[2] Atlas of Operative Gynecology. By Barton Cooke Hirst, M.D. Philadelphia and London: J. P. Lippincott Company, 1910.

even a tyro might learn from these pictures to acquire a correct technique. While this may be true, the desirability of such a purpose might well be argued. Is it not the trend of modern opinion that operative technique should be acquired by assisting at operations rather than from books?

The views expressed in the text are based on personal experiences of many years. The experiences of others are referred to only in so far as they have produced a reaction upon the author. This book, then, is essentially a *confessio medici*, and some of the opinions propounded are, therefore, open for discussion. But whether or no there are debatable points here and there, the reviewer has found keen delight in reading this book from cover to cover and he predicts a like experience for the many who will give this work its well-deserved attention.

The reviewer can not refrain from adducing, at random, at least a few selections. Hirst's plan of protection against wound infection is very elaborate. The evening before the operation, the abdomen is shaved, thoroughly cleansed for ten minutes with a 1 per cent lysol solution, and then with alcohol. This cleansing is repeated the next morning and finally a moist dressing of a 1 per cent formalin solution is applied. Upon the operating table, the line of incision is wiped with a 5 per cent solution of thymol in alcohol, the abdomen is incised, a piece of rubber dam is laid over the incision, then cut through over it, and after the incision has been completed, the edges of the peritoneum are sewed to the edges of the rubber dam. His choice of anæsthesia is nitrous oxide gas followed by the ether drop method. Other methods may be used occasionally, but spinal anæsthesia is tabooed. In fresh perineal or cervical tears, the author prefers to wait with the repair work until the fifth day after delivery, and he claims more uniform results for his method. The advice to stretch the torn sphincter before attempting to unite the edges, seems very valuable. Postpartum cystocele is usually due to a frank or concealed injury of the muscle and fascia of the urogenital trigonum, and therefore requires separate attention. In his interposition operation Hirst carefully resects the tubes in younger individuals; yet, he has observed pregnancy in three cases. In such women he, therefore, prefers the Goffe operation or a method of his own, but he very frankly admits a fairly large percentage of recurrences. In the much debated question as to the clinical dignity of retrodisplacements, he holds that symptomless cases are the exception and that the majority of patients require treatment, preferably of an operative nature. He has, by surgical means, even cured several cases of actual epilepsy associated with retroflexion. He favors a combination of an Alexander-Adams with a laparotomy through a Pfannenstiel incision, but whatever method he employs in a given case, he adds, as a safety measure, a temporary suspension of the uterus with a single catgut suture. He rejects the operations for anteflexion of the type of the Dudley or Reynolds procedures and likewise expresses himself opposed to vaginal hysterectomy for prolapse. On the other hand, he has found dilatation very useful in sterility and reports cure in 43 per cent. The results of dilatation can be made even more secure and lasting by employing electrolysis. The details of all the procedures mentioned must be read in the original or studied by his telling pictures. In the controversy of the removal of both tubes in ectopic pregnancy he takes the stand that the unaffected tube should be saved. In 167 tubal gestations, he observed a repeated ectopic only in seven cases, while thirty children were born in a natural way. In the last five years he has performed forty Wertheim-Bumm operations for cancer of the uterus with only three deaths, or 7½ per cent mortality—a most encouraging and inspiring result in this country.

There is no need for further details. Intensely individualistic though it is, the book compels admiration and stimulates discussion; and the publishers should come in for their share of the general appreciation with which this work will be accepted

NOT long ago the statistician for the Commonwealth of Australia, in a monograph on population, made a forecast of so colossal an increase in the world's population as to put a severe strain on the resources of Nature. That prediction probably has the distinction of being the only one of its kind. Long before the war, the authorities in almost all civilized countries were of a different opinion, and today every thinking person realizes the seriousness of the situation. The obstetricians have been among the first to suggest practical means to check further depopulation. Their particular aim is directed toward the greatest possible reduction of fœtal mortality, and from this standpoint, a booklet of barely a hundred pages, which has just arrived from abroad, claims our earnest attention. While this little brochure[1] deals primarily with conditions in Germany, it is applicable to any country.

The author has set himself the task of showing how the loss of children in labor may be prevented or at least reduced to a minimum. After estimating the percentage of fœtal mortality during labor and investigating, in a second chapter, the various causes of fœtal death, he proceeds to a discussion of the dangers to the child during the second stage of normal labor and the means of recognizing and combating these dangers. It may be said parenthetically that Benthin considers a second stage of more than two hours abnormal. If between contractions the fœtal heart beats remain below 100 or rise above 180, labor should be terminated at once. The following seven chapters deal with the means of saving the child's life in contracted pelvis, placenta prævia, eclampsia, and the various forms

[1] Die Erhaltung des Kindeslebens in der Geburt. By Prof. Dr. Walther Benthin. Berlin and Vienna. Urban und Schwarzenberg 1919.

of pathological presentations. The proposed measures are based upon carefully compiled statistics and the large material of the university hospital in Koenigsberg where the author occupies a teaching position. He repeatedly refers to American statistics. The only omission found is this that the influence of narcosis upon fœtal mortality has not been taken into consideration.

His conclusions are briefly these: It lies in the power of the obstetrician to render the state an immediate service by protecting the child's life in labor. His chief object must be to preserve both mother *and* child. The interest of the mother is paramount, but that of the child has not always been equally safeguarded. Obstetrical technique is so highly developed nowadays that a way may always be found to do justice not only to the mother but to the child as well. An improvement of existing conditions may be expected from more frequent hospitalization of obstetrical cases and an elevation of the obstetrical *niveau* of the profession.

FORTUNATELY there are forces at work in our country to bring about this most desirable object. Our textbooks on obstetrics are particularly praiseworthy. The reviewer has several such before him.

De Lee's *Obstetrics*[1] is one of those textbooks that is a distinct asset to American medical science. Within five years it has appeared in three editions and numerous reprintings, an eloquent proof of its well-deserved popularity. In the present third edition the author has succeeded in incorporating even the latest Continental obstetric literature and thus has brought his book strictly up to date. It is safe to say that under the conditions of the war no other book has attained a like completeness. Comparatively few changes from the last edition were needed. The Abderhalden reaction, the relation of the endocrine glands to gestation, twilight sleep, and the urinary tests for the toxæmias of pregnancy required new evaluation. Other subjects, mainly of a practical nature, were amplified. Among these, the author's greater interest in the conservative treatment of eclampsia is particularly interesting. It is, however, not necessary to go into further details. A mere announcement of this work will suffice and will be welcomed by students and teachers both here and abroad.

THE subject of obstetrics from the standpoint of the operator finds a very able presentation in a new book by Leavitt.[2] The methods of dealing with the various pathologic conditions causing dystocia are presented in thirty-two chapters. In each, the indications for any given intervention are clearly stated; the preparations for, and the technique of, every procedure are succinctly set forth; any difficulties likely to be encountered, are pointed out, and the prognosis outlined. The scope of the book also includes topics which strictly speaking are not classified under the heading of dystocia, such as postpartum hæmorrhage, abortion, asphyxia of the newborn, and ectopic pregnancy. The views expressed conform with the best teachings of the day, and the large personal experience of the author has enabled him to place the emphasis on the proper points. Dwelling, for instance, on the necessity of waiting for sufficient dilatation of the cervix, or warning against undue force in forceps extractions are obstetrical aphorisms that cannot too often be reiterated. Commendable, too, is the advice to make an episiotomy a little too long rather than too short, lest it serve the undesirable purpose of being the starting point for an extensive tear. While operative obstetrics properly belongs in a hospital, the author does not lose sight of the exigencies of daily practice and supplies his readers with suggestions as to how to carry out the necessary procedures at the home of the patient. In the matter of anæsthesia, he is non-committal as to "twilight sleep." Spinal anæsthesia for the more severe lacerations seems to appeal to him though it is questionable whether many will accept this indication for spinal anæsthesia. In prolapse of the umbilical cord with the head still above the pelvic inlet, he prefers podalic version and extraction to cæsarean section; yet the latter procedure would seem the more rational as the condition mentioned is more likely to occur in a contracted pelvis.

The greatest obstacle, the beginner—and it is to him that the author addresses himself primarily—encounters in operative obstetrics, is the difficulty of appreciating dimensions without the guidance of the eye, and in this he will be greatly aided and comforted by the numerous and excellent illustrations. In short, the book represents safe and sane obstetrics and teachers should gladly recommend it to their students.

A COMPENDIUM of pathological and operative obstetrics which, within a small compass, covers an amazingly large ground, has recently been published by McNeile.[3] As a means of review and as a summary of more extensive reading, the student will find this booklet of immense value. The practitioner, too, would do well to slip it into his pocket and consult it while "on a case." The tenor of the book with its clear-cut instructions is such as to engender an "obstetric conscience" and to increase a due regard for the welfare of the unborn child. These *Notes* will occupy a useful niche in the book-world.

[1] THE PRINCIPLES AND PRACTICE OF OBSTETRICS. By Joseph B. DeLee, A.M., M.D. Philadelphia and London: W. B. Saunders Company, 3d ed., 1918.

[2] THE OPERATIONS OF OBSTETRICS EMBRACING THE SURGICAL PROCEDURES AND MANAGEMENT OF MORE SERIOUS COMPLICATIONS. By Frederick Elmer Leavitt, M.D. St. Louis: C. V. Mosby Company, 1919.

[3] NOTES ON PATHOLOGICAL AND OPERATIVE OBSTETRICS. By Lyle G. McNeile, M.D. Los Angeles: The Division of Obstetrics, College of Physicians and Surgeons, Medical Department of the University of Southern California, 1919.

BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

A Guide to Gynecology in General Practice. By Comyns Berkeley, M. A., M. D., M. C. (Cantab.), F.R.C.P (Eng.), and Victor Bonney, M.S., M.D., B.Sc. (Lond.), M.R.C.P. (Lond.). London: Oxford University Press, 1919.

The Narcotic Drug Problem. By Ernest S. Bishop, M.D., F.A.C.P. New York: The Macmillan Company, 1920.

Modern Surgery, General and Operative. By John Chalmers DaCosta, M.D., LL.D., F.A.C.S. 8th ed. revised and enlarged. Philadelphia and London: W. B. Saunders Company, 1919.

The Diseases of Infants and Children. By J. P. Crozer Griffith, M.D., Ph.D. 2 vols. Philadelphia and London: W. B. Saunders Company, 1919.

Orthopedic and Reconstruction Surgery, Industrial and Civilian. By Fred H. Albee, A.B., M.D., D.Sc., F.A.C.S., Lieutenant Colonel M.C., U.S.A. Philadelphia and London: W. B. Saunders Company, 1919.

Herman's Difficult Labour; a Guide for Students and Practitioners. 6th ed. revised and enlarged. By Carlton Oldfield, M.D. (Lond.), F.R.C.S. (Eng.). London: Cassell and Company, Ltd., 1920.

The Nose, Paranasal Sinuses, Nasolacrimal Passageways, and Olfactory Organ in Man. A Genetic Developmental, and Anatomicophysiological Consideration. By J. Parsons Schaeffer, A.M., M.D., Ph.D. Philadelphia: P. Blakiston's Son & Co., 1920.

The After-Treatment of Surgical Patients. By Willard Bartlett, A.M., M.D., F.A.C.S. and collaborators. 2 vols. St. Louis: C. V. Mosby Company, 1920.

Suites de Couches Normales et Pathologiques. By E. A. Rene de Cotret. Montreal: Librairie Deom Frere, 1919.

Food for the Sick and Well; How to Select it and How to Cook it. By Margaret J. Thompson, R. N. Yonkers-on-Hudson, New York: World Book Company, 1920.

Syphilis. A Treatise on Etiology, Pathology, Diagnosis, Prognosis, Prophylaxis, and Treatment. By Henry H. Hazen, A.B., M.D., St. Louis: C. V. Mosby Company, 1919.

The Medical Aspects of Mustard Gas Poisoning. By Alfred Scott Warthin, Ph.D., M.D., and Carl Vernon Weller, M.S., M.D. St. Louis: C. V. Mosby Company, 1919.

The Woman of Forty. By Dr. E. B. Lowry. Chicago: Forbes & Co., 1919.

A Textbook of Gynæcological Surgery. By Comyns Berkeley, M.A., M.C., M.D. (Cantab.), F.R.C.P. (Lond.), M.R.C.S. (Eng.), M.R.C.P. (Lond.). 2d ed. London: Cassell & Co., Ltd., 1920.

Rambling Recollections; an Autobiography. By A. D. Rockwell, M.D. New York: Paul B. Hoeber, 1920.

Injuries to the Head and Neck. By H. Lawson Whale, M.D. (Camb.), F.R.C.S. (Eng.), with preface by Colonel Frederick F. Burghard, C.B., M.D., M.S., F.R.C.S. New York: Paul B. Hoeber, 1920.

Physical Reconstruction and Orthopedics. By Harry Eaton Stewart, M.D., New York: Paul B. Hoeber, 1920.

DR. MARCELINO HERRERA VEGAS

Professor of Surgery and Dean of the Faculty of Medicine, University of Buenos Aires.

AMERICAN COLLEGE OF SURGEONS

SOUTH AMERICAN SURGEONS

Official Visit to Peru, Chile, Argentine, and Uruguay in Behalf of the American College of Surgeons, by Dr. William J. Mayo, President, and Dr. Franklin H. Martin, Secretary-General

By FRANKLIN H. MARTIN, M.D., F.A.C.S.

I. INTRODUCTORY

SINCE the inception of the American College of Surgeons, its organizers have had in mind that the College should become comprehensively American, eventually including in its Fellowship all worthy surgeons of the American continents.

During 1914 and 1915 a preliminary correspondence with the surgeons of South America was entered into by the office of the College, under the guidance of a special Spanish-speaking secretary, who conducted the correspondence in Spanish. This was undertaken as a precursor of a visit that was to be made in the winter of 1915–1916. The European War, which was threatening the usefulness and safety of the shipping routes of the Western Hemisphere, coupled with our own interest in the conflict, compelled us to postpone further thought of an immediate visit to the southern continent.

Upon the signing of the armistice, it became apparent that, with the educational institutions of Europe disorganized and European travel discouraged, this time was particularly opportune for the revival of our plans to visit the surgeons of the various countries of our own South America.

The suggestion came almost simultaneously from our President, Dr. W. J. Mayo, and other members of the Board of Regents of the College, and with an assurance on the part of the President that he personally would make the trip, our correspondence was hurriedly revived, travel arrangements promptly made, and January 7 set as the time for our departure.

On December 20, the Secretary-General laid the tentative plans before the Board of Regents, and they were received with hearty approval. As a preliminary, committees of surgeons in Peru, Chile, Argentine, and Uruguay were selected, and we communicated to the individual members of each committee the object of our contemplated visit, informing them at the same time of the approximate time of our arrival. The following extract from this correspondence will reveal more definitely our plans:

> . . . The principal object of our tour is to enlist the interest of the surgical profession of your countries in the American College of Surgeons, with the idea of ultimately extending to the surgeons of South America an invitation to become Fellows of the College. . . . Could you arrange to have a small group of from five to ten of your surgeons meet with us at the time of our visit to discuss our problem? Fellowship in the American College of Surgeons is open to all general surgeons and surgical specialists. . . . Therefore, in selecting the group for the preliminary conference, you may take into consideration these specialties. . . .
>
> At our conference we would suggest that the following matters should be considered:
>
> "1. As a means of promoting a closer affiliation between the professions of the South and North American continents, will the surgeons of your country desire to become Fellows of the American College of Surgeons on an equal basis with the surgeons of North America?
>
> "2. Should you favor such affiliation, will you have prepared in advance and furnish to us at our conference a carefully selected list of the eminent surgeons of your country who, because of their standing in the profession, should be recommended for Fellowship in the College without examination?
>
> "3. Will you be prepared to suggest to us at the conference a plan that will aid in bringing about a closer relationship between the surgeons of your country and the surgeons of the United States and Canada?"
>
> In order that you may become familiar with the organization of the American College of Surgeons and may have some knowledge of the personnel of its officers and Fellows, we are mailing you a copy of our directory. . . .

Upon viséing our passports, the several South American consuls imparted to their respective ambassadors in Washington information in reference to our contemplated visit. The Pan American Union in Washington secured facts regarding our plans and proceeded to make the occasion the subject of diplomatic correspondence.

NOTE.—The illustrations intended for use with this article were delayed in the mails, and will appear later in another article.

Before leaving New York, the president and secretary-general of the College received letters from Mr. Lansing, Secretary of State, commending our proposed trip and informing us that he had communicated concerning the subject with the United States ambassadors in the capitals of the countries included in our itinerary.

Letters were also received from the ambassadors to the United States from Peru, Chile, Argentine, and Uruguay, stating that they had cabled to their respective governments the facts concerning our contemplated mission.

On January 7 the president and the secretary-general of the College, with their wives, sailed from New York on the S.S. "Ebro," an 8,000-ton steel ship flying the British flag. The itinerary included Jamaica, Panama, Peru, Chile, Argentine, and Uruguay.

From the standpoint of the surgeon, the trip had interest in the medical schools, the hospitals, and the operating surgeons of the four countries of this southern continent that we were privileged to visit. The short time at our disposal and the difficulties of transportation made it impossible for us to include Brazil and the several other South American countries. However, visits to these countries will be undertaken as soon as proper arrangements can be made. This trip, undertaken as a purely professional one in behalf of the American College of Surgeons, cannot be properly described without relating some of the unusual personal experiences we enjoyed.

II. THE VOYAGE

It is an ordinary experience to board an ocean liner and be deposited in one week in Liverpool or Cherbourg. It is, however, an *unusual* experience for a North American to board a commodious steamer for a long sea voyage of six weeks to our southern continent. Especially is it unusual when one leaves Rochester, Minnesota, and Chicago in January, with the temperature ranging from zero to ten degrees below, with the necessity for winter garments, and finds oneself three days out of New York in the warm Gulf Stream, with the tropics in anticipation, and summer clothing in demand.

We sailed from New York on January 7, and anchored in Valparaiso harbor on February 1. With a few intervening stops at interesting ports, this represented the first arm of the sea voyage which may be summarized by the one word "ideal." At no time was there a sea of sufficient roughness to cause one the slightest discomfort. The sun shone almost continuously, and there was but one rainfall, and that in the small hours of the morning when the ship's voyagers were asleep. After passing Cape Hatteras the temperature on shore or ship was at no time above 85° F. or lower than 50°. It was possible to sit on deck at all times with light wraps or none at all, and, fanned by a cool breeze that was always present, read a book, dream over a cigar, or while away the time enjoying the companionship of old friends or those newly made, and at any time supply the inner man with the good things which were afforded by the well-equipped ship which was sailing a sea that was always "wet." The climate for six long weeks was like the most perfect June day in Chicago, when a gentle breeze is blowing from off the lake. Considering these ideal weather conditions, and our splendid boat with canvas canopies over the broad decks, with much space in which to exercise, with comfortable chairs, with music in the lounge, with a well-stocked smoking room, with salt and fresh baths, with a swimming pool, and, to cap all, with comfortable beds and the unusual, clean, plain table of a well-conducted English ship, supplemented by strange fruits from tropical parts, one would have to be especially difficult to please if he could not find here contentment and satisfaction. It must become the overworked and the tired man's paradise.

III. THE CONTINENT

The *Conquest of Peru* has left in the minds of civilization a romantic impression of South America which fits well one's imagination during a visit to the whole continent. I believe one of the great charms of South America lies in its barren shore line and the occasional oasis in the form of an important seaport. From Panama, where the second break of the trip occurs, Kingston being the first, there is a two days' sail due south without a sight of land, and on the third day one comes abreast of the great promontory of Equador, and from there to Valparaiso he is in constant sight of the dry, brown coast range of mountains, with an occasional glimpse of the snow-capped second and more important range. The first stop south of Panama was at the port for Lima—Callao. The Pacific is so undisturbed and calm that the ships anchor in the open sea and transport their passengers to the dock by row boats or little launches, loading and discharging their cargoes from lighters. Eight miles from Callao, which is a flat little seaport town of about four thousand inhabitants, and connected with it by a broad boulevard and by trolley, is the capital of Peru—Lima. This city and its seaport

are typical of all seaport towns on the western coast, as far south as Valparaiso. The mountains surrounding the coast are absolutely barren of foliage; rain is almost unknown; and the sun-dried mountains have crumbled, and everywhere at their base, except where the sea washes, is a long, straight line of deep brown dust that constantly sifts down from above.

Lima is typical of the nearby inland cities. They are always the source of water supply and are real oases in sterile rock, mountain-bound valleys. These valleys "bloom like the rose" as soon as water is turned into them. Growing in the dust-covered earth are royal palms, fruit-bearing trees of all kinds, and a wealth of foliage and tropical flowers. Every house has its patio and each is the central attraction of the habitation. And so with Arica and its inland oasis city—Tacna; also Antofagasta, Valparaiso, and Santiago.

From Valparaiso we traversed the continent and landed at the metropolis of South America—Buenos Aires, and made the last reach by viewing the Atlantic Ocean at Montevideo. It is no small experience for the traveler who is familiar with the Trans-Andean route to make it again and again, and how much more eventful it is for one traversing it for the first time. An unusual ride from the scenic standpoint is the first arm of the journey to Los Andes, Chile, an oasis city. The climax is reached, however, in the climb by cog railroad to the top of the Andes, penetrating by a two-mile tunnel a lofty final obstruction, the road reaching a height of 10,470 feet, with the highest peaks of the two continents towering in grandeur, snow-capped, far above the dizzy height. Then the descent on the Argentine side to Mendoza, the center of the grape-growing province. Finally, one enters a special train of sleepers and diners on the broad gauge road, which takes the traveler across the broad pampas, which are covered with a wealth of wheat, corn, and grazing cattle and sheep, and conveys him to Buenos Aires. An overnight ride on a comfortable steamer of palatial equipment completes the trip to Montevideo.

In this continental journey one traverses two proud republics and enters a third. In crossing the first, Chile, he enters two cities of importance and travels among the foothills of a mighty mountain range, with deep valleys and raging torrents of rivers, and appreciates the interest that is excited by a new civilization in a strange land, and all the picturesqueness of an Alpine scene. This develops finally into the grandeur of the Canadian Rockies, as one crosses the divide, and there is revealed Aconcagua, the premier peak of the continent, with its worthy satellites. Then one begins the descent, picking one's way over almost impossible abysses on a roadbed that is the pride of engineers of international fame; and at last a great empire of agriculture that reminds one of the plains of the Dakotas, Montana, Minnesota, and Illinois, arriving at a metropolis that brings to mind Rome and Paris rolled into one, which houses a people who are proud of their great country and know how to welcome the stranger.

IV. OUR WELCOME

We did not have to wait until we reached South America to feel the warm handclasp of welcome. Standing on the dock at Colon was our friend, and the official Sanitary Officer of the Canal Zone, Colonel H. C. Fisher. We last knew him in the Surgeon General's office in Washington during the strenuous days of the war. He was in uniform, appearing almost boyish in his white helmet, and his face was good to look upon. We dined with him that evening, together with our wives, meeting at dinner other friends of war time—Colonel Greenleaf, Sanitary Officer of Panama; and Colonel Hess, in charge of the Government Hospital at Balboa. Afterward at a reception we met the principal members of the medical fraternity of this little Republic. We were particularly interested in the inspection of the City of Panama the next day, under the guidance of Dr. Braithwaite.

On anchoring at Callao, the port for Lima, our ship was soon besieged by launches, and in one of the first was Antonio Grana, Esq., a business man of Lima, who came to pay his respects to Dr. Mayo. His launch was followed by another with a group of Lima surgeons, representing the Sociedad de Cirugía del Perú. We were informed by Drs. Aljovin, Grana, Gastaneta, Denegri, and Macedo of the committee that we were to take automobiles from Callao to Lima, and become the guests of the Society at the Hotel Maury during our three days' stay at Lima. The eight-mile trip by motor along the sea boulevard was most enjoyable, as it gave us the first shore glimpse of this rainless country. Our days were full, the intervals between conducting the business of our mission being crowded by hospitable attentions which were accorded to us by the surgeons of Lima and Callao, the government of Peru, and our own United States representatives residing there. Before disembarking, we were welcomed by our American Consul and the Chargé d'Affaires, representing the American

Embassy, who bore invitations for us to visit the Minister of Foreign Affairs and the President of the Republic that afternoon. Dr. Guillermo Gastaneta was our host at luncheon at the Botanical Gardens that day, and a group of surgeons of Lima were additional guests.

At four o'clock, Mr. William Walker Smith, the Chargé d'Affaires, visited us and we made official calls upon the Minister of Foreign Affairs, and afterward on the President of the Republic. The palace of the President was built by Pizarro in about 1540, and occupied by him as his official residence. While waiting we were shown the spot where Pizarro was assassinated, and were then conducted by relays of red-coated officials to the executive apartments. There we were met by the secretary, who took us into the audience chamber where the President greeted us. He is an attractive, vivacious man of rather small stature who speaks English perfectly, and we were soon engaged in an animated discussion of our mutual friend, Major General William C. Gorgas. The President reminded me of our own Secretary of War, Mr. Baker—the same keen, intellectual type of man.

That evening Dr. Juvenal Denegri, president of the surgical society, gave an official dinner that was attended by about sixty men and women. This was an elaborate banquet given at the Botanical Gardens, and it was an affair that emphasized the exquisite taste of these delightful people. An address directed to the President of the College, Dr. Mayo, was read by Dr. Denegri. Dr. Mayo formally responded. This occasion added to the cordiality of our reception and stamped it as official. The next day we, together with the ladies of our party, were entertained by Professor Miguel C. Aljovin at a luncheon at his home, the first luncheon in which an attempt was made to give us Peruvian dishes exclusively. The dining room opened onto a patio filled with flowers, growing palms, and cages of highly-colored birds who vied with a native mandolin orchestra playing Peruvian airs. Here we succeeded in getting the home atmosphere of the people of Lima. The next day Dr. Denegri entertained us at luncheon at the Union Club, and in the evening we were the guests of Antonio Grana, Esq., at a dinner at his interesting residence. In the afternoon we attended a garden party at the American Embassy given by Mr. and Mrs. William Walker Smith. There are many memories that will frequently hark back to our visit in Lima. The unobtrusive but continuous hospitality of these people, with their cosmopolitan ways and cultivated minds, is something that we can never forget. Our welcome was not by any means wholly official, as there was much that was personal, because of the affection that many Peruvians have for our chief, Dr. Mayo. Not until we had been deposited on our ship, loaded with fruits and other dainties, and our adieus had been said, did we realize to the full the friendships that we had made.

And this was but the beginning of entertainments that continued wherever we touched the continent, and at all times on our land trips. Even at the small ports we were greeted by officials and physicians. At Arica we had been prepared by a wireless from our American Consul to meet the Governor of the Province, the *intendente*, Mr. Edwards, of Tacna. At Arica a special coach awaited us, consisting of an enclosed body built on a Ford auto, with flanged wheels that traversed the railroad. We were conveyed to it by the Consul, Mr. Cameron; the Governor; and Dr. Tomes Aravena, of Arica. The invitation included Dr. and Mrs. Mayo, and Dr. and Mrs. Martin. On arriving at Tacna we were greeted by Mr. Edwards, the *intendente*, Mr. Eliot, the English Consul, and two physicians. Our luncheon in the palace of the *intendente*, with his wife, four daughters and a son, and guests, was one of the most interesting experiences of our trip. We viewed the beautiful gardens afterward, and then were taken by Mr. Eliot to inspect a new hospital of which he has every reason to be proud. This city of Tacna is thirty miles from the sea, at an altitude of 1,800 feet, and is an oasis with a population of ten thousand.

At Antofagasta and Iquique we were carefully looked after, at the latter port by Dr. J. E. Villalon Diaz and Dr. Germán Aliago, both local surgeons of renown; and at the former city, Antofagasta, by Dr. W. F. Shaw, an American stationed at the copper mines at Chuquicamata, the captain of the post, and Dr. A. Arturo Pemjean. We were shown the clean city, inspected a hospital and were entertained at luncheon in a large public garden.

At Valparaiso the first launch brought a distinguished group of men who had come to greet us, pay their respects, and take us to the dock. They were lined up and we were introduced to Dr. Edwyn P. Reed; Dr. Vincenti Daguino, Viña del Mar, president of the medical society of Valparaiso; Dr. Gaston Lachaise, secretary of the medical society of Valparaiso; Dr. R. de la Fuente, Dr. Alberto Adriasola, and Dr. Prain, of Valparaiso; Professor Correo Pardo, Professor José Ducci, Dr. Luis Vargas, and Dr. Juan de Diaz, of Santiago. Our stay at this port was short,

but we visited the town, and before taking our Trans-Andean train at noon we had refreshments at the Naval Club with Dr. Adriasola, Surgeon General of the Chilean Navy, as our host. In ten days we returned to this city in the special Pullman that the government had furnished us and were literally carried away by the committee of surgeons which had greeted us on our arrival in port.

At Viña del Mar, a suburb of Valparaiso, they intercepted us and conveyed us in automobiles to a tropical garden where, in the shade of enormous trees, a wonderful banquet table was spread. A large oval canopy was stretched overhead, and in the background were the American, English, and Chilean flags. The entertainers were headed by Dr. Vincenti Daguino, who made us a formal address which was responded to briefly by Dr. Mayo, Dr. Martin, Dr. Reed, Dr. Muenich, Dr. Avarosus, and Dr. Adriasola. Then our hospitable friends conducted us to our dock and by special launch took us to our ship which had been awaiting us for two weeks.

At Buenos Aires we were greeted both officially and medically. Reporters boarded our train about an hour out of the city. On alighting at the station we were immediately greeted by Mr. Welles, representing the American Ambassador, who formally conveyed that official's greetings to us. Then appeared a delegation of doctors from the Faculty of Medicine. General introductions were indulged in. Heading the group were Dr. Marcelino Herrera Vegas, Dr. Marcelo T. Vinas, Dr. Pedro Chutro, and Dr. José Arce. After much flashlight photographing on the part of a battery of newspaper men, we were conveyed to the Plaza. There for two hours in the corridor of the hotel we held an informal reception and met many of the physicians and surgeons of Buenos Aires.

There was much for us to see and accomplish in this metropolis, and our professional and official social entertainments were many and most interesting. The first day after inspecting hospitals we were "breakfasted" at the Jockey Club, where we were especially distinguished by having large goblets of actual ice water served in honor of Dr. Mayo. The luncheon was much appreciated as our hosts had been our guides during the morning. The Jockey Club is the pride of this city, and is not surpassed anywhere. It reminded us of Paris, New York, or London.

At noon we paid our respects to the American Ambassador, Mr. Frederic Jesup Stimson, a Boston man of the type of Senator Lodge, but much younger. Our greeting was most cordial and we had an enjoyable call, conducted without interpreters. We were invited to tea for Sunday afternoon.

Dr. Chutro took us on a unique trip in the afternoon to El Tigre. This is a freak of nature of LaPlata which converts a large area of land adjacent to it into many islands by offshoots which resemble artificial canals. These islands are covered with summer residences and luxuriant fruit orchards.

Saturday was enjoyed with an excursion by automobile as guests of Dr. Vegas to his *hacienda*, or landed estate. It consists of forty-five square miles of agricultural territory lying about half way between Buenos Aires and LaPlata. We were accompanied by Dr. Cranwell and his daughter, and Dr. Pasman and his brother. This is one of the largest and most attractive landed estates in Argentine. This day's visit to Dr. Vegas' estate, which is one of the side interests of this remarkable surgeon, is worthy of a separate chapter. However, our day was not completed until we motored on to LaPlata. On the way we could fix in our minds a few commercial facts regarding this estate, on which there are one hundred thousand cattle, two hundred thousand sheep, and other animals in proportion, and on which is raised quantities of grain, corn, and produce.

On reaching LaPlata we were the guests of the president of the Universidad Normal de La Plata. We breakfasted in one of the corridors of the University. The professor of anatomy, Dr. Pedro Belou, made an address in Spanish, to which we responded in English. We were then driven about the beautiful but deserted city of LaPlata and returned to Buenos Aires by motor. It was a distinguished group that we met that evening at dinner at the American Embassy. One of the interesting men we met on this occasion was the *intendente* of Buenos Aires. On Sunday another estate was visited by Dr. and Mrs. Mayo and Mrs. Martin as the guests of Dr. Pasman and Dr. Cranwell. They were entertained at luncheon, and then taken to the races, which are the most attractive Sunday diversion of these people. Later they took tea at the American Embassy.

Montevideo welcomed us with open arms. A letter from our Ambassador, Mr. Robert Jeffery, in Montevideo, to our Ambassador in Buenos Aires had given us advance information to the effect that a committee from the Faculty of Medicine would welcome us. Accordingly, when the gang plank of our steamer connected us with the dock at Montevideo, the first to

come over it was a committee headed by the Ambassador, Mr. Jeffery. The committee of surgeons and physicians consisted of Dr. Enrique Pouey, Dr. Gerardo Arrizabalaga, Dr. Horacio Garcia Lagos (who speaks English fluently), Dr. Alfredo Navarro, Dr. A. Ricaldoni, dean of the Faculty of Medicine, Dr. Lorenzo, Dr. Carlos A. Belliure, Dr. Alfonso Lamas, and Dr. Julio Nin y Silva. General introductions were in order, after which we filed onto the upper deck and were duly photographed by newspaper men.

We were then driven to Montevideo where we inspected the medical school, accompanied by about seventy-five members of the faculty and students. Later we drove about the city and were shown with pride the new sea boulevard which is named for President Wilson. After transacting some business, we were taken to the Parque Hotel where we lunched with a group of government officials and medical men. The luncheon was an elaborate one served in the great dining room of the hotel, in which a large number of other people were being served, including a luncheon party given by Mrs. Jeffery for the ladies of our party. At the end of the feast the president of the faculty read an address to the guests which was translated into English by Dr. Ernesto Dowling. Dr. Mayo responded, followed by Dr. Martin. These two talks were, in turn, translated into Spanish. Mr. Jeffery arranged an interview for us with the Minister of Foreign Affairs in the afternoon. We were very graciously received, and the Minister expressed genuine good will toward our country. He reminded us that Uruguay had followed us into the great war because Uruguay looks upon the United States as its protector against foreign aggression, and when the United States feels compelled to enter European wars, Uruguay automatically follows. Hence she broke diplomatic relations with Germany immediately after our declaration of war. He regretted very much that the President of the Republic was away for the day, and he conveyed to us the President's regrets. The importance of our visit from the point of view of the government may be judged by the fact that this Minister, corresponding to our Secretary of War, was at the ship that night to see us off. Greater cordiality than we received could not have been extended to anyone in the short time we had to spend in Montevideo.

The next morning we were met by many of our friends at Buenos Aires, in spite of the fact that we had but a few minutes to spend in transferring from the Montevideo boat to our transcontinental train. We arrived in Los Andes, Chile, the following evening. At this point we were to change from the narrow gauge Andean train to the normal gauge Chilean train. The Governor called to inform us that he had instructions from his government in Santiago to look after our comfort and to attach to our train a special Pullman coach for the use of our party while in Chile. He then introduced us to the transportation chief who he said would accompany us. This was most welcome news as our party was much fatigued after the exciting journey. Fortunately the coach accommodated more than our immediate party, and we shared it with our other American fellow travelers.

At nine o'clock the next morning we were met at the Hotel Savoy in Santiago by a committee of local surgeons. Heading the delegation were Professor Gregorio Amunategui, Dr. José Ducci, secretary of the Faculty of Medicine, Dr. Correa Pardo, Dr. Victor Koerner, Dr. Francisco Navarro, and Dr. Jerman Valenzuela. We were whisked off to an inspection of hospitals and medical schools and ended up at the home of Professor Amunategui for a luncheon which was given by himself and his wife for our ladies and a number of medical men, including also our Ambassador, Mr. Joseph H. Shea. This was another enjoyable luncheon of the formal type that was made unusually pleasant by its family character. Dr. Amunategui is another of the cultured type of Spanish gentleman that wins one's heart by his genial hospitality and his genuine cordiality. In the evening the members of the Faculty of Medicine and their wives gave a large dinner for us in the restaurant on the famous island mountain, Cerro de Santa Lucia. This was a fitting finish for our official visit to this capital.

The next day we boarded our special train and were accompanied to Valparaiso by a brother of Dr. Lucas Sierra, the latter being in Europe, and Dr. José Ducci. We said goodbye to our friends who had gathered at the station to see us off and started for the coast. The final curtain was rung down on our entertainments when we again reached Lima on our return. A wireless had been received by us asking that we become the guests at a luncheon at a seaside resort between Callao and Lima, and witness a bull fight the following day, Sunday and Washington's birthday. We felt that this would be a fitting climax to a continental trip of two surgeons.

The pace had been a fast one. We reached Lima on January 22. Our official visit to South America, occupying just one month, was ended.

From our previous landing here until our escort left us at six o'clock on February 22, we had been in the hands of committees, civil and governmental, that had kindly but persistently entertained us. We had visited Lima, Santiago, Valparaiso, Buenos Aires, and Montevideo, and had crossed the continent twice from ocean to ocean. No company or commission has ever been entertained more royally, more dignifiedly, or more hospitably. At every station we were shown attentions that indicated that our own government had neglected no opportunity to impress upon our hosts the importance of our mission, and the governments of the countries that we visited were not slow in responding. Mr. William Walker Smith at Lima, Mr. Joseph H. Shea at Santiago, Mr. Frederic Jesup Stimson at Buenos Aires, and Mr. Robert Jeffery at Montevideo, our ambassadors and envoys, had neglected nothing which emphasized the importance of our visit. And, best of all, what can we say of the entertainment that we received from the surgeons of South America on our own account? It has been a proud month to the writer of this sketch to see our president and chief, Dr. Mayo, honored everywhere and always. No conquering hero has ever been accorded more royal treatment. "Mayo" has become a household word in four countries where before it was only known by reputation. This visit we hope will be the foundation for the establishment of a more personal friendship between the professions of our two continents.

V. MEDICAL SCHOOLS

We visited medical schools connected with the national universities at Lima, Santiago, Buenos Aires, and Montevideo. A primary, high-school, and university education is required by the medical schools for the admission of students. Peru, Chile, and Argentine require a seven-year course of medicine, while Uruguay requires but six. So far as we could judge them in our cursory visit, the physical properties of each of these four schools were adequate and modern in every detail. Judging from the provision for free hospital beds in so many of the hospitals of the cities in which the schools are situated, which are under the control of the faculties, the clinical material should be abundant. The laws of each of the governments provide for a reasonable distribution of dissecting materials, and postmortems are an accepted requirement. Our opportunity for meeting a strong group of each faculty was most favorable, and if the faculty as a whole approaches in point of ability the members with whom we became acquainted, the faculties are exceptionally strong. While it was vacation time and the medical schools were not operating at full capacity, we had an opportunity of observing and meeting a large number of students and a larger number of recent graduates who were serving as internes in the hospitals, and I am sure we were agreed that in appearance they compared favorably with those of the United States, Canada, and England.

The leaders of the faculties are men who have supplemented their home training by study in France, Germany, or other foreign countries, while a few have been in the United States. One cannot but realize that these medical schools are built on sound, fundamental bases. However, it was not possible for us in a short visit during the summer vacation season to judge of their present teaching value.

VI. HOSPITALS

The hospitals in South America, not unlike the hospitals in other civilized portions of the world, may be divided into several classes. One of the objects of our trip was to obtain a bird's-eye view of the hospitals in the cities we visited. We passed through, very hurriedly of course, a number of the principal hospitals in each of the capitals, and Valparaiso and a few other cities. With only minor exceptions, they all had suitable buildings and interiors, and opened onto extensive and attractive gardens or patios. Without exception, I believe all of them have a system of case records, and the average of completeness in this respect was above that found in the United States. Everywhere working laboratories, including X-ray outfits, were in evidence and were pointed to with pride. The operating rooms, with but few exceptions, were modern, and contained the most approved sterilizing apparatus. Conveniences for diagnostic purposes, and instruments for operating rooms were in abundance. Nearly all had provision for postmortems, and up-to-date morgues. The provision for graduate internes seemed to be adequate, especially in those hospitals connected with teaching institutions. Nearly all of the large hospitals had rather complete out-door dispensary departments. Some of the hospitals were deficient in modern plumbing. However, a large percentage of the important hospitals were elaborately equipped with these conveniences. Some had the most approved hydrotherapeutic departments, and modern laundries and kitchens were in evidence in nearly all of the larger institutions. The hospitals which did not have the

full equipment as enumerated above were not a few, but nearly all of these are in line for a rapid readjustment. Especially is this true since their teachers are thoroughly alive to the requirements of a modern hospital.

Two defects which were evident in nearly all of the hospitals visited and which appealed to us as rather easy to remedy were the lack of screening against flies, mosquitoes, and other insects, and a well organized system of nursing. The former of these will soon be remedied, and the latter is a difficult problem with which the faculties are wrestling. It was not a defect pointed out by us, but was freely admitted by our hosts.

The Modelo Instituto Clinica in Buenos Aires may well be taken as a model for all hospitals built in a climate such as Argentine's. It is one of the most beautiful from the standpoint of architecture and grounds, and its equipment, as far as we could judge, with the exception of the nursing organization, is complete in every detail. It was built as a model by the government of Argentine, and is maintained as such, which fact evidences the yearning of the people and the profession of this country for the best that can be devised. This hospital is also completely screened.

VII. THE SURGEONS

Peru. The Sociedad de Cirugia del Peru is of recent origin, and was established along the lines of the successful societies of the United States and Europe. The organizers have had the courage of their convictions, and have carefully selected their members. They have built themselves an attractive home in which to meet, to house their literature, and to entertain the stranger. The membership is limited to surgical specialists, and its members do not yet number twenty.

Nowhere in the world, I am sure, can the modern surgeon find himself more at home than among the surgeons of Peru; they are all men of the highest type; they are educated and possess the culture that comes from travel and study abroad, and they are conversant with at least one language besides their own. Nearly all of them speak French, a large percentage some English, and many of them converse with ease in the English tongue.

When we consider the personnel of these hosts of ours immediately come to mind the following: Dr. Miguel C. Aljovin, surgeon of the Maison de Santé, honorary member of the Faculty of Medicine; Dr. Constantino J. Carvallo, professor of descriptive anatomy; Dr. Juvenal Denegri, professor of otology, rhinology and laryngology, surgeon to Santa Ana Hospital; Dr. Guillermo Gastaneta, professor of clinical surgery, surgeon to Dos de Mayo Hospital; Dr. Francisco Grana, professor of surgical pathology, surgeon to Guadalupe Hospital; Dr. Carlos Morales Macedo, professor of applied anatomy, surgeon to Guadalupe Hospital; Dr. Carlos Villarán, professor of clinical surgery, and surgeon to Military Hospital; Dr. Mariano Alcedan; Dr. Constantino T. Carvallo, professor of gynecology; Dr. Manuel J. Costaneda, surgeon to Italian Hospital; Dr. Enrique Febrea Odriozola, professor of obstetrics; Dr. Juan J. Mostajo, surgeon to Italian Hospital; Dr. Ricardo Palma, instructor of anatomy of the Faculty of Medicine; Dr. Ricardo Pazos Varela, professor of genito-urinary surgery, surgeon to Dos de Mayo Hospital; Dr. Luis de la Puente, surgeon to Maison de Santé, honorary member of the Faculty of Medicine; Dr. Belisario Sosa Artola, professor of syphilis and skin diseases, surgeon to Bellavista Hospital.

Santiago. We have already spoken of our reception at Valparaiso and of our entertainment by the surgeons of Santiago. We found a genuine desire on the part of our committee of surgeons here to co-operate and to become affiliated in the work of the American College of Surgeons. We could not have had a more influential chairman than Dr. Gregorio Amunategui, and in our formal meeting we had the services of a young medical man as interpreter, although nearly all of the Chileans understand some English. Besides the chairman, the following surgeons were discussed and recommended for our consideration: Dr. David Benavente, Dr. Marcos Donoso, Dr. Liva Eujenio Diaz, Dr. Carlos Charlin, Dr. Victor Koerner, Dr. Eduardo Moore, Dr. Olejandro Mujica, Dr. Francisco Navarro, Dr. Correa Canpolican Pardo, Dr. Emilio Petit, Dr. Alejandro del Rio, Dr. Lucas Sierra, Dr. Jerman Valenzuela, Dr. S. Luis Vargas, Dr. Wall Jerónimo Alvarado, Dr. Silvano Sepúlveda, Dr. Alberto Adriasola, Dr. Luis Obalos, and Dr. Guillermo Muenich.

Valparaiso. It was considered desirable to consult committees in the two large cities of Chile, and accordingly we also met in conference with a selected group of surgeons in Valparaiso. We had already spent a pleasant forenoon with the members of this distinguished committee and looked forward to our conference with a great deal of pleasure. Our meeting was held in a beautiful garden in one of the favorite summer resorts near Valparaiso. The occasion was quite formal and Dr. Alberto Adriasola, the chairman, read an address and modestly suggested a few

names of surgeons whom they recommended for Fellowship in the College. Among those suggested were many men whom we had already met. Including his own name, these consisted of Dr. Guillermo Muenich, who, with Dr. Adriasola, had been recommended by the Santiago committee, Dr. Silvano Sepúlveda, Dr. Frederico Engelbach, Dr. Roberto Montt, Dr. Rudecindo de la Fuente, Dr. Juan Thierry, Dr. Miguel Manriquez, Dr. Ernesto Iturrieta, and Dr. Gaston Lachaise.

There seems to be the most cordial co-operation between the surgeons of these two Chilean cities. The surgeons of this country, like the leading men everywhere in South America, are of the broadest type. Their European travel and their familiarity with several languages besides their own, gives them a breadth of vision that is frequently lacking in many of our surgeons who are provincial in spite of the very bigness of their country.

Buenos Aires. On Friday, February 6, we met the committee of surgeons of Argentine which was interested in our mission in behalf of the College of Surgeons. In the conference were Drs. Vegas, Cranwell, Chutro, and Palma. Buenos Aires has a strong body of surgeons and surgical specialists. A modern city of a million and a half inhabitants, of necessity, would possess such a group. There are also a number of strong provinces of Argentine with cities of considerable importance. These, too, have their surgeons of quality. Our interview and discussion revealed the fact that the surgeons of this Republic are desirous of affiliating in the most cordial manner with the surgeons of the North American continent.

They submitted a list that they felt they could unreservedly recommend to the College. They also suggested a committee that would from time to time make further recommendations and pass on applications which naturally would come independent of them. It was gratifying to note the seriousness with which this group of men accepted the responsibility. The tentative list recommended contained the names of many men whom we had met on our previous visit. It is not an exaggeration to say that it would be difficult to find a group of surgeons in any capital of Europe or America which would excel the following:

José Arce
Nicomedes Antelo
Pedro Benedit
Eduardo Belaustegui
Enrique Bazterrica
Pedro Ovidio Bolo
Adrián J. Bengolea
Guillermo Bosch Arana
Daniel J. Cranwell
Pedro Chutro
Antonio F. Celesia
Pedro Caride Massini
Máximo Castro
Bartolomé N. Calcagno
Alejandro Ceballos
Oscar Copello
Delfor del Valle (hijo)
Juan B. Emina
Enrique Finochietto
Ricardo Finochietto
Avelino Gutierrez
Angel G. Gallo
Marcelino Herrera Vegas
José M. Jorge (hijo)
Castelfort Lugones
Luis Lenzi
Carlos Lagos García
Adolfo M. Lopez
Adolfo F. Landivar
Jorge Leyro Diaz
Francisco Llobet
José F. Molinari
Armando Marotta
Bernardino Maraini
Arturo J. Medina
Salvador A. Marino
Angel F. Ortiz
Pascual Palma
David F. Prando
Julio S. Passeron
Aquiles Pirovano
Rodolfo E. Pasman
Carlos Robertson Lavalle
Manuel Ruiz Moreno
Rodolfo A. Rivarola
Alberto Rodriguez Egaña
Ricardo Rodriguez Villegas
Miguel Sussini
Roberto M. Sole
Ricardo Sarmiento Laspiur
Luis A. Tamini
Herman Taubenschlag
Nicolás Tagliavache
Marcelo T. Viñas
Leandro Valle
Arturo Zabala
José A. Viale
Ricardo Spurr
Pedro Del Pino
Pedro Belou
Benjamín Abalos
Roberto Halahan
Eliseo V. Segura

Montevideo. We have dwelt upon the hospitality displayed by the profession of this important and interesting city. Our official greeting here was of the most cordial nature. The committee called a meeting in the amphitheater of the new hospital and we had the pleasure of meeting several members of the Faculty of Medicine who were not surgeons. The object of our visit was reviewed by Dr. Martin and interpreted by Dr. Lagos, and then amplified by Dr. Mayo. The list of surgeons who were finally recommended is only tentative and is to be supplemented by a few other names later on. This list is as follows:

Gerardo Arrizabaloga
Enrique Pouey
Horacio Garcia Lagos
Lorenzo Merola
Manuel Quintela
Juan Pou Orfila
Augusto Turenne
Alberico Ysola
Alfonso Lamas
Alfredo Navarro
Carlos A. Belliure
Julio Nin y Silva

We have met in the surgeons of South America men of outstanding influence. There is something about their appreciation of worth that makes the man of education, culture, and professional ability the natural leader. Is it because of their world vision, brought about by their knowledge of foreign languages, their supplementary education in other lands, their love of general literature and the classics, and their dread of narrow provincialism?

GIFT OF $75,000 FROM CARNEGIE CORPORATION. MUNICIPAL HOSPITALS OF NEW YORK CITY APPROVE STANDARDIZATION

TWO events of interest in the progress of hospital standardization during the past month are, first, a gift of $75,000 from the Carnegie Corporation to the College to be used for hospital standardization; second, the hospitals of New York City, under the direction of the Department of Public Charities, officially adopted the standardization plan of the College.

The present gift from the Carnegie Corporation is the second which the Corporation has made to the College. In 1916 the Corporation gave $30,000, making a total now of $105,000 for hospital standardization. This amount is supplemented by funds of the College.

"By these gifts," said Mr. John G. Bowman, "the Carnegie Corporation has done more than to give financial aid to hospital standardization. It has given encouraging approval and world-wide recognition to the work. The trustees of the Corporation voted unanimously in favor of the appropriation, the subject being presented to the board by Dr. Henry S. Pritchett, President of the Carnegie Foundation for the advancement of Teaching, and by Mr. Elihu Root.

As the outcome of a meeting of the staffs of the hospitals under the direction of the Department of Public Charities in New York, held at the Academy of Medicine on the evening of January 23, plans were adopted for a review each month of the clinical records of these hospitals by their respective staffs. The medical profession in New York has long been aware that these hospitals maintain adequate case record systems for all patients; also that the laboratories of these hospitals are well equipped, well managed, and dependable. The one thing that remained to do was to institute staff meetings at these hospitals at which clear, concise reviews of what each staff had accomplished for the right care of its patients each month should be fearlessly considered. These staffs agreed unanimously that the time had come for such meetings and they therefore carried the plan through.

The data to be reviewed at the staff meetings each month are as follows, minor adjustments being made naturally as the needs of the hospital and the judgment of the respective staffs may indicate:

ANALYSIS OF HOSPITAL SERVICE

for month ending.....

DISCHARGED

Cured
Improved
Relieved
Unimproved
To return for secondary operation
Admitted for diagnosis only
Deaths within 48 hours
Deaths institutional
Released
Labor
Newborn

Total Discharged

DIAGNOSES

Provisional and final agree
Provisional and final disagree
Discharged with additional diagnosis
Discharged with no diagnosis made
Labor
Newborn

Total Diagnosed

INFECTIONS

Institutional		On Admission	
Medical		Medical	
Surgical		Surgical	
Obstetrical		Obstetrical	

Total Infections

DEATHS		AUTOPSIES	
Medical		Medical	
Surgical		Surgical	
Obstetrical		Obstetrical	
Newborn		Newborn	
Stillborn		Stillborn	
Total deaths		Total Autopsies	

CONSULTATIONS

Asked and obtained
Asked, not obtained
Indicated, not asked

In addition to the foregoing data, analyses are also called for, first as to causes of death and, second, as to records of patients discharged as unimproved.

CHRONOLOGICAL STATEMENT OF HOSPITAL STANDARDIZATION

May 5, 1913 — American College of Surgeons organized in Washington, D. C. Betterment of service in hospitals among objects of College.

June 22, 1914 — Plan to raise permanent endowment fund for the College approved by the Fellows, the income from this fund to be used in carrying out purposes of the College.

December 1, 1915 — Endowment fund of $526,000 subscribed by Fellows of the College.

January 27, 1916 — Gift of $30,000 from the Carnegie Corporation, New York, to be used for hospital standardization.

September 27, 1916 — American Hospital Association in session at Philadelphia invited to co-operate with College in hospital standardization. Association appointed a committee to co-operate with the College as invited.

October 27, 1916 — Plan to organize State and Provincial Committees on Standards to guide and aid in the program of hospital standardization voted by Fellows.

November 30, 1916 — Members of State and Provincial Committees on Standards elected by ballot.

January 11, 1917 — Plan of hospital standardization, in relation to Catholic hospitals, approved by His Eminence James Cardinal Gibbons at Baltimore.

October 19-20, 1917 — Meeting of the State Committees on Standards in Chicago. Throughout two days the following subjects were considered:

1. The number, distribution, valuation, and general classification of hospitals; and the relation of hospitals to the general public.
2. What the profession of medicine wants in hospitals.
3. How to bring about desired conditions in hospitals.

About three hundred members of State Committees on Standards and sixty leading hospital superintendents present at Conference. The papers presented, together with summary of discussion, published as Bulletin, Vol. III, No. 1.

October 25, 1917 — General Hospital Committee of twenty-one appointed by Regents to outline questionnaire and consider the minimum standard as advised by Conference, October 20.

December 8-9, 1917 — General Hospital Committee met in Washington with Regents of College. An initial questionnaire formulated. Details of minimum standard considered with reference to the following: a system of financial accounting and of making annual reports; uniform nomenclature; the training of superintendents; the training of internes; the training of nurses; hospital organization; staff rules and regulations; the function of staff meetings; case records and follow-up of records; postmortem examinations; clinical laboratories; the out-patient department; the economic relation of the hospital to its community; ethics of medical practice in the hospital; education of patients and of the community in matters of health, hygiene, and sanitation; the responsibility of the hospital to the patient; encouragement of medical research and of medical education; the hospital library; continuity of service to patients by doctors; dietetics; the testing of materials and supplies before purchase; the receiving and checking-out of materials and supplies through the hospital storeroom; model plans for new buildings and additions; and means of increasing the financial support of the hospital.

December 10, 1917 — Meeting of Governors of College in Washington. Program of hospital standardization approved. Consensus of opinion that the work should be carried out through personal inspections by staff members of the College.

February 15, 1918 — General hospitals of 25 or more beds invited to co-operate with College in hospital program. Invitation and questionnaire sent to 2,711 hospitals. Copy of invitation and of questionnaire sent also to Fellows for their information.

March 1, 1918 — Minimum standard and plan of hospital standardization sent to hospitals and to Fellows. Bulletin, Vol. III, No. 3.

April 1, 1918 — Work of personal investigation of hospitals begun. Investigations limited to general hospitals of 100 or more beds. Visitors or inspectors employed to explain to hospital trustees, superintendents, and staffs the hospital program of College and to make specific reports of hospital conditions as indicated by minimum standard. Report forms designed for this purpose. Co-operation of Fellows with visitors. An illustration of a visitor's report follows:

HOSPITAL STANDARDIZATION REPORT

Name of Hospital: Blodgett Memorial Hospital, Grand Rapids, Michigan.
Date of Visit: March 15, 1919. *Visitor:* Anna C. Phillips.
Type: General. *No. of beds:* 125.
No. of Internes: None; usually 3. *No. in nurses' training school:* 71.
Staff Organization: Open hospital without definitely organized staff; no review or analysis of professional work; division of fees not permitted.
Case Records: Current records consisted only of nurses' notes, anæsthetic record in surgical cases, and final diagnoses. Occasional physical examinations and laboratory reports were found among the filed records. Records filed on shelves in general office by clerk.
Clinical Laboratories: Pathological: accessible, light, well equipped; no pathologist, no technician; facilities used occasionally by attending doctors. X-ray: accessible, well planned, completely equipped; no technician; facilities used only occasionally by attending doctors.
Notes: Conditions as to staff organization, case records, and laboratories discussed with executive committee of board and with superintendent; work of College explained. Effort being made to secure laboratory technician. Board responsive and much interested. Glad to co-operate. Ideals of all connected with hospital excellent.

SUMMARY OF FINAL ACTION REPORTED AUGUST 12, 1919

Staff Organization: Staff reorganized, meets bi-weekly to consider the character of the clinical service and other matters relative to the care of patients, such as laboratory service, etc. In the reorganization there are two groups:

1. Executive Group: Experts in special fields of work.
2. Associate Group: General practitioners.

In accepting appointment to staff, physicians and surgeons are required to agree to the following:

> "To abide by the rules and regulations of the Hospital, and to adhere at all times to the well recognized, lofty principles governing the reputable practice of medicine and surgery.
>
> "That as a principle I shall not engage in the division of fees under any guise whatever, nor knowingly permit any agent or associate of mine so to do.
>
> "To exercise to the best of my ability a constructive interest in the Hospital, and to co-operate in making it as potent a factor as possible in the preservation of public health in this community."

Case Records: A complete new record system instituted July 1, 1919. Complete case records including personal history, physical examination, working diagnosis, laboratory findings, treatment or operation, progress notes, and final diagnosis are kept for all classes of patients treated, free and pay.
Clinical Laboratories: The X-ray department is in charge of a full time roentgenologist; the pathological laboratory is in charge of a full time technician; serological and histological work sent to outside laboratory.

June 20, 1918 — Meeting in Chicago of Catholic Hospital Association. The following resolutions were passed:

Be it resolved, That we, the Catholic Hospital Association of the United States and Canada, now assembled at Chicago in our third annual convention, approve of the work being done by the American College of Surgeons for the standardization of hospitals, and assure the College of our fullest co-operation in its endeavor for the betterment of hospitals and the resultant increased welfare of mankind.

Be it resolved, That we, the members of the Catholic Hospital Association, pledge ourselves to organize controlled staffs in our hospitals; to establish or continue an adequate system of case records, with a Sister in charge having full authority to demand the careful co-operation of doctors, internes, and nurses; to secure from our superiors, staffs, or friends, funds properly to equip all necessary laboratories and to bring about as soon as possible the scientific training of our Sisters and technicians of all kinds, anæsthetists, dieticians, record-keepers, and social service experts.

We further pledge ourselves to urge all surgeons who are privileged to practice in the hospitals of the Association, and who are not at this time Fellows in the American College of Surgeons, to qualify as soon as they are able for Fellowship in the College.

We further wish to express our desire that all doctors who practice in our hospitals be or become, as soon as practicable, members in good standing of their respective county medical societies and contribute their share to the active medical life of said societies.

We further wish to express our conviction that the secret division of fees, as condemned by the American College of Surgeons, is an unethical and nefarious practice which we pledge ourselves to keep out or root out of our hospitals.

June 21, 1918 — Meeting in Chicago of Bishops and Archbishops(or their representatives) of the Catholic Church in the United States and Canada to consider the program of the College in relation to Catholic hospitals. Program of the College approved.

September, 1918 — Meeting in Hamilton, Ontario, of the combined Surgical Section of the Ontario Medical Association and the Canadian Medical Association. The following resolution was passed:

Be it resolved, That we, the Surgical Section of the combined meeting of the Ontario Medical Association and the Canadian Medical Association, desire to go on record as approving the efforts being made by the American College of Surgeons to improve the status of surgical practice in our hospitals . . . that the right to attempt major surgery should be restricted to those who are recognized as having scientific training, experience, sound judgment, and honesty of purpose . . . that examinations for diagnosis and for treatment should be made more closely associated with clinical laboratories than they are at present. . . .

October 23, 1918 — Hospital conference arranged to be held in New York in connection with the Clinical Congress of the College. Fellows of the College and hospital superintendents of the United States and Canada invited. Meeting cancelled because of influenza.

January 15, 1919 — Bulletin, Vol. IV, No. 1, published. Detailed explanation of the minimum standard with special reference to the meaning and use of case records; 27,000 copies distributed.

January 15, 1919 — Bulletin, Vol. IV, No. 2, published. Forms suggested for the keeping of case records in a simple, convenient, and adequate manner; 27,000 copies distributed.

February 1, 1919, to May 15, 1919

Hospital conferences, many of them including one or more states or provinces, arranged throughout western half of United States and Canada. Hospital standardization presented to hospital trustees, superintendents, medical profession, nurses, and to general public. These conferences usually included special meetings with county medical societies, chambers of commerce, business men's associations, and Canadian clubs. The conferences were designed to supplement the work of the hospital visitors on the staff of the College. Meetings were held at St. Louis, Memphis, New Orleans, Fort Worth, Denver, Ogden, Salt Lake, San Diego, Los Angeles, San Francisco, Portland, Tacoma, Seattle, Victoria, Vancouver, Calgary, Edmonton, Regina, Winnipeg, Minneapolis.

The following program is typical of these occasions:

HOSPITAL STANDARDIZATION CONFERENCE

PORTLAND AND VICINITY

April 11, 1919

LUNCHEON, CHAMBER OF COMMERCE, 12:15 P.M.

A. L. MILLS, Presiding

The Hospital and its Community . . . . . JOHN G. BOWMAN
Director of College, Chicago
and CHARLES B. MOULINIER, S. J.
President Catholic Hospital Association, Milwaukee

AFTERNOON SESSION, 2:00 P.M., LINCOLN HIGH SCHOOL

The Occasion for the Conference . . . . . DR. KENNETH A. J. MACKENZIE
Chairman State Committee on Standards

What is Hospital Standardization? . . . . . JOHN G. BOWMAN
(Clinical Laboratories, Case Records, Staff Organization)

Discussion:

(a) Clinical Laboratories . . . . . DR. A. E. MACKAY
MAJOR R. L. BENSON

(b) Case Records . . . . . MAJOR RALPH C. MATSON
MAJOR WM. S. KNOX

(c) Staff Organization . . . . . DR. S. E. JOSEPHI
DR. E. F. TUCKER

Summary . . . . . CHARLES B. MOULINIER, S. J.

EVENING SESSION, 8:00 P.M., LINCOLN HIGH SCHOOL

Hospital Progress; The Citizen's Part . . . . . A. L. MILLS
What the Medical Profession Wants in Hospitals . . . . . JOHN G. BOWMAN
Team-Work for Success . . . . . CHARLES B. MOULINIER, S. J.
Summary of Conference . . . . . DR. KENNETH A. J. MACKENZIE

September 11, 1919

American Conference on Hospital Service organized at Cincinnati. Chairmanship of committee in charge of standardization of hospital service voted to American College of Surgeons.

October 24, 1919

Report to Fellows of the College in connection with the ninth meeting of Clinical Congress of the College, New York, concerning hospital standardization as applied to general hospitals of 100 or more beds. The practical administration of the minimum standard presented.

SURGERY, GYNECOLOGY AND OBSTETRICS

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A GENERAL METHOD OF REPAIRING LOSS OF BONY SUBSTANCE AND OF RECONSTRUCTING BONES BY OSTEOPERIOSTEAL GRAFTS TAKEN FROM THE TIBIA

273 OBSERVATIONS

BY HENRI DELANGENIÈRE, LE MANS, FRANCE, AND PHILIP LEWIN,[1] M.D., CHICAGO

A GENERAL method of repairing loss of bony substance and of reconstructing bones by osteoperiosteal grafts consists not only in grafting bone and periosteum but also in transplanting into the defect all elements of a callus which subsequently will be converted into new bone. The method is applicable in the treatment of pseudarthrosis, in effecting the obliteration of a bony cavity or trephine opening, in rebuilding bones partially or even completely, or in producing a strong arthrodesis. The grafts are usually obtained by removing from the tibia thin layers of bone with the periosteum. The grafts may be taken from any bone provided the two layers of periosteum and bone be used, but the internal surface of the tibia is best because of its large size and because it is easily obtained. (If a large amount of bone is to be replaced, both tibiæ may be used.) The periosteum of the tibia is particularly vascular, and therefore well adapted for easy grafting and secondary rapid vascularization of the bony layer, so that all elements of a callus are supplied, namely, living periosteum and bone, the latter being indispensable in the production of new bone.

It is not the purpose of this paper to discuss the question as to whether new bone is secreted by the periosteum alone, or if it is produced by osseous transformation of connective-tissue cells or even of blood clot. Suffice to say, one can be certain that a layer of bone with its periosteum produces new bone, and that this bone gradually grows and replaces lost bone, and assumes the shape of the bone to be reconstructed. Figure 3, shows a large defect of the tibia filled in by a unilateral osteoperiosteal graft made three and a half years ago. A large, heavy callus nearly as large as the tibia, and taking the shape of that bone, is seen.

The osteoperiosteal graft need not necessarily be in contact with osseous tissue, but can be kept alive and growing when transplanted into soft tissues beneath the skin of the forearm, for example, as the author has done in 2 cases in preparing the skeleton of the nose for an Italian graft.

The graft is taken from the internal surface of the tibia using a single bevel engraver's chisel, and a hammer or mallet. A long incision is made through the skin over the middle of the internal surface of the tibia, without cutting the periosteum. The latter is

[1] It was my good fortune while on duty as camp orthopedic surgeon, American Embarkation Center, Le Mans, Sarthe, France, to see Lieutenant Colonel Henri Delangenière, chief surgeon of the French 4th Region, perform his operation many times, and to be his first assistant in several cases. When the term "author" is used H. Delangenière is meant. —Philip Lewin, Major, M. R. C., U. S. A.

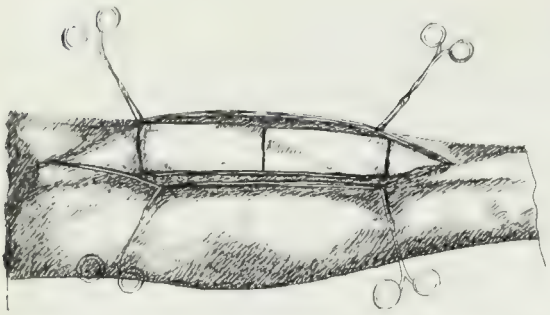

Fig. 1. The internal surface of the tibia exposed and grafts outlined, one below the other.

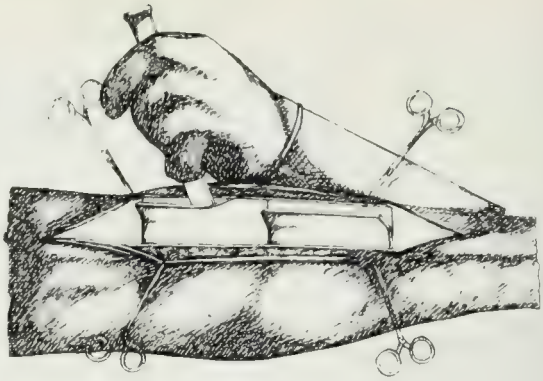

Fig. 2. Removing the graft by means of the chisel. The graft curls up as it is being removed.

exposed thoroughly and the grafts are outlined with a scalpel (Fig. 1). The size of the grafts is determined by the defect to be covered. Following the outline, the graft is removed with a chisel. The bevel is kept high and the cutting edge firmly against the bone. By varying the inclination, one obtains the proper thickness which is approximately that of a ten-cent silver coin. When the graft is removed it is placed in a compress and immediately transplanted into the wound of reception which has been thoroughly prepared previously.

General considerations, which apply to all grafts and to which strict adherence is necessary, are as follows:

1. Most strict asepsis is required. Slight suppuration will not prevent the graft from "taking," but will cause delay. Infection will often cause the elimination of the graft.

2. Antiseptics should not be used because they always reduce the vitality of the graft.

3. Bones to be grafted must be entirely free from osteitis. The skin must be healthy and sufficient in amount and elasticity easily to close the wound.

4. It is necessary that both surfaces of the graft come in contact with living tissues so that there will be no dead spaces. The extremities of the graft must be in contact with the ends of the bone to be repaired.

5. The graft should be held in place by means of catgut sutures through muscles. All dead spaces must be obliterated by this means. Ligatures, sutures, plates, etc., are always harmful to the vitality of the grafts. Quite exceptionally, wire will be found indispensable.

The method is best suited to the following types of cases:

Cranioplasty. The wound must be completely healed and the skin in sufficiently good condition to re-cover the opening without traction. One must guard against latent infection in the wound and delay operation long enough to be sure that perfect healing has taken place; the least discharge or the smallest fistula necessitates postponing operation. It is also necessary, if the patient has cerebral trouble, to determine by spinal puncture that there is no reaction on the part of the central nervous system.

When it has been determined that the patient is in suitable condition for operation, the orifice to be bridged is uncovered at the site of existing scars, which should be removed at the same time in order to obtain primary union. Flaps are turned back and the orifice of the skull is well freed by a periosteal elevator, and the periosteum of the skull is lifted up all around the opening for a space of 2 or 3 centimeters, in order to permit of the easy introduction of the graft. Then the periosteum of the skull is lifted up and the grafts introduced one after the other under the periosteum, carefully placing the bony, or secreting surface, inward. The grafts are placed next to each other like the boards of the floor so that they cover the entire

opening and extend beyond, at least 1 centimeter, in every direction. The skin is then folded back and sutured with interrupted silk-worm, as is done in all autoplasties. Drainage is not necessary unless one fears a hæmatoma, when it is desirable to drain for 48 hours.

If, for a clinical reason of any kind, one fears irritation of the meninges by the production of bone from the grafts, it is necessary to return to the author's original method, placing the smooth periosteal surface next to the brain. In every case one must shape the grafts by means of forceps, before putting them in place so that they will assume the exact form of the skull to be repaired.

Pseudarthroses of the maxilla with or without loss of bony substance. Here the co-operation of the specialist in maxillofacial prostheses is indispensable. It is he who prepares the patient by treatment of the mouth and bad teeth, and who prepares beforehand the apparatus which will hold the jaws together. This apparatus consists of two gutters held together by silver wire. Before operating, the wound must be completely cicatrized and all fear of suppuration eliminated. It is often necessary to perform one or two preparatory operations to be sure that the skin is sufficiently supple and viable to cover grafts completely. The wound is opened at the site of the scar and the ends of the bone exposed by means of a periosteal elevator, taking great care not to penetrate into the mouth, which accident is guarded against by the introduction into the mouth of an assistant's finger. When the ends are denuded as far as possible, the maxilla is reduced the required distance and the grafts are placed one in front and one behind or one gutter below, overlapping the bony ends 1 or 2 centimeters on all sides to prevent the formation of a secondary pseudarthrosis at the level of the ends of the grafts. In rebuilding the angle of the jaw one places two grafts in the angle. The wound is well padded by means of the soft parts to prevent a dead space and to retain the grafts in their place. The skin is sutured as in all autoplasties. Drainage is useless; in fact, may be very dangerous because of the nature

Fig. 3 (at left). Large loss of bony substance of the tibia replaced by unilateral osteoperiosteal graft inserted three and one-half years ago. Note the large, heavy callus nearly as large as the tibia, and assuming the shape of that bone.

Fig. 4. Pseudarthrosis of the humerus with loss of bony substance cured in 3 months by osteoperiosteal graft.

of the site of the wound. Nevertheless it is necessary to drain if hæmostasis is imperfect or a hæmatoma is likely to form.

The operation just described is applicable to the ordinary cases of pseudarthrosis of the horizontal portion of the maxilla. It must be modified for the middle part of the bone and for the angle. In the middle it is not possible to secure in good position a posterior graft, so one must simply place a long anterior graft under the periosteum which has been lifted up on each side as a tunnel so that the graft does not become displaced downward by the upper muscles of the neck. At the angle, grafts must be placed vertically in a line with the vertical portion of the maxilla, and in contact with that vertical part. One or two other grafts are then placed on the horizontal part of the maxilla and the three

Fig. 5 (at left). June 5, 1919. Before grafting. Showing loss of bony substance of tibia.
Fig. 6. Same as Figure 5, November 25, 1919, five and one-half months after grafting. Not yet quite solid.

Fig. 7 (at left). Ulna before operation.
Fig. 8. Same as Figure 7, after grafting. Solid union

or four grafts are joined together and fastened with catgut passed through all the layers.

Pseudarthroses of the long bones with or without loss of bony substance. The same rule applies as in repair of the maxilla. Simple pseudarthroses are exposed, bony ends denuded, cicatricial tissue carefully excised, and the grafts placed lengthwise all around the denuded ends.

For loss of substance it is necessary thoroughly to denude the bony extremities, to put them in good position, and to place two grafts lengthwise of the bone, going beyond the ends for a distance of 2 or 3 centimeters so that each end shall be overlapped by the two grafts. The secreting surfaces are applied next to the denuded bone. When it is possible, one graft should be placed inside and one outside. In the free space between the two bony ends the secreting surfaces of the graft face each other. The muscular layer is sutured over the grafts with catgut, in order to prevent a dead space, and the skin is closed. During the operation the best position of the limb is obtained, and in this position it is immobilized in a circular cast with windows. In this way the bony ends are held in place during the formation of the callus and regeneration of bone.

A few modifications for specific cases are as follows:

Femur. When there is a gap of more than 5 centimeters, the ends should be held by means of wire and the grafts placed around them. The wire should be removed at the end of a month and the cast should be changed.

Humerus. The same rule applies as for the femur; a wire can be passed through the bony ends to hold them at the proper distance and to prevent displacement. The cast is applied and must include the chest and arm. Roentgenograms should be made to assure proper position of the fragments. (Fig. 4.)

Tibia and fibula. The fibula may be disregarded. It is necessary to repair the tibia only. For the tibia alone three grafts are necessary; one between the two ends of the bone, one behind and one in front (Figs. 5 and 6).

Ulna and radius. Wire may be used for the radius. Two grafts are required for either

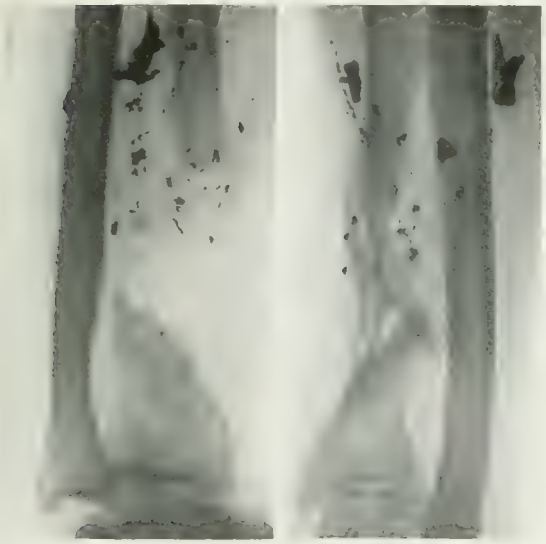

Fig. 9 (at left). Radius before operation.
Fig. 10. Radius after grafting.

Fig. 11 (at left). Flail shoulder before operation. August 17, 1919.
Fig. 12. Same as Figure 11, November 22, 1919, 3 months after grafting. Very solid. Wire still in place.

bone (Figs. 7, 8, 9, and 10). For the ulna alone two grafts are necessary but no wire (Fig. 8). For the radius alone two grafts are necessary but no wire (Figs. 9 and 10).

Obliteration of bony cavities. The bony cavity must be well sterilized and thoroughly curetted before the grafts are placed in the cavity. The grafts are placed one on top of the other. They grow and fill up the cavity with new bone. It is absolutely necessary that there be sufficient viable skin to cover the grafts completely.

Large facial and other grafts. It is possible to restore missing parts of the face, nose, walls of sinuses, malar bone, superciliary ridge, and orbital fossa. The grafts must be molded and trimmed to take the form of the bone to be replaced. In order to obtain good results, the most important point is to secure a point of bony contact for each graft. It is also necessary that the tissues be well padded and secured by catgut and a normal skin, which has been prepared in advance for an autoplasty.

Flail shoulder. In cases of flail shoulder, grafts are used to produce a very strong and heavy callus, which can firmly unite the end of the humerus, which has been well denuded, to the glenoid cavity, from which the cartilage has been removed. This arthrodesis will result in a very useful shoulder if the arm is held in abduction in a spica cast over the chest and arm during the formation of callus. A wire is necessary to hold the bones in good position. It must be removed when the callus is ossified, that is, about 3 months after operation (Figs. 11 and 12).

Flail knee. In treating flail knee the same rules apply as for flail shoulder. A wire is used to keep the end of the femur against the end of the tibia after all articular cartilage has been removed. One graft is placed on each side, bridging the gap, and overlapping both bones, which can be easily accomplished by bending each graft in the middle.

Flail elbow. In flail elbow, the bony ends are well denuded; a wire is passed through the humerus and the ulna to hold them together. Grafts are then placed completely around the denuded bones, and the arm, held in good position, is placed in a cast (Figs. 13 and 14). (Before operating, the elbow should be flexed at 70° to 90°.)

Fig. 13 (at left). Flail elbow, before operation.
Fig. 14. Same as Figure 13, 6 months after operation. Elbow quite solid. Wire has been removed.

Flail wrist. In a case of flail wrist treated by the author, the radius and ulna had been excised for a distance of about 4 centimeters above the wrist-joint. Four grafts, each of the same length as the width of the forearm, were placed, one above another, filling in the gap. The skin was sutured and the wrist immobilized in a plaster-of-Paris cast. No wire was used.

Evolution of the graft. The evolution of the graft is easily followed by the X-ray which shows the bone growing more and more dense and thick. As thickening becomes more marked in the X-ray, one recognizes clinically, by palpation, the growth and hardening just as in a fracture callus. Therefore, it is evident that the osteoperiosteal graft acts not only as a graft but that it secretes bone, thus uniting the fracture ends and finally producing callus, which rebuilds bone and reestablishes continuity of function.

The graft may grow too abundantly in very young people. This result is rare and of no importance except in reconstructing the face, especially the nose. Because of this possible excessive growth, the author at first placed grafts in cranioplasty operations with the periosteal surface next to the brain. Later, however, he found that this fear was exaggerated, and that the grafts could be placed with the bony side next to the brain.

Absorption of the grafts has never been observed. Where the graft has been eliminated the result will certainly not be the best but it will not be worthless; the bone will be thinner and less dense, but bone will form in the majority of cases, provided the expulsion of the graft did not carry away the entire bony layer.

Wound of the tibia. The wound of the tibia is insignificant. It heals primarily. It is well to drain in order to prevent a hæmatoma. No grave complications have ever occurred. At times a hæmatoma may develop; at times the discharge of small spicules of bone occurs. Generally the wound has healed at the end of the eighth day.

RESULTS

The results of the first operations were, indeed, very satisfactory, but the technique has been perfected so that it can now be stated that osteoperiosteal grafting is nearly always followed by reconstruction of the bone. This report is based on 273 observations of osteoperiosteal grafts, as enumerated below, and covers the use of the method under normal and abnormal conditions. The following results were obtained:

Cranioplasties, 104 cases with 99 very good or good results, 3 partial repairs and 2 failures following the elimination of the grafts. However, these two cases were operated upon again with good results.

Loss of bony substance of the inferior maxilla, 53 cases with 43 good results, 4 partial successes, and 6 bad results which will necessitate secondary operations.

Wounds of the femur, 3 cases with 1 very good result, 1 unknown result, and 1 late death in the case of an intractable alcoholic who died from chronic septicæmia 3 months after operation.

Wounds of the tibia, 15 cases with 13 very good results, and 2 partial cures.

Wounds of the fibula, 2 cases with 2 good results.

Wounds of the humerus, 15 cases with 13 good results, and 2 partial cures.

Wounds of the ulna, 23 cases with 19 good results, 3 unknown, and 1 failure due to the entire elimination of the graft.

Wounds of both ulna and radius, 3 cases with 2 good results, and 1 followed by a new pseudarthrosis which was cured by a second operation.

Wounds of the radius, 12 cases with 11 good results, and 1 incomplete cure.

Obliteration of bony cavities, 9 cases with 9 cures.

Repair the face, 21 cases with 19 good results, and 2 incomplete cures.

Flail knees, 3 cases with 3 good results.

Flail shoulders, 3 cases with 3 good results.

Flail elbows, 4 cases with 4 satisfactory results.

Flail wrist, 1 case with a good result.

Radical cure of hernia, 1 case with a good result.

Relapsed luxation of the hip, 1 case with a good result.

THE OPERATIVE TREATMENT OF VESICOVAGINAL FISTULÆ[1]

By E. S. JUDD, M.D., F.A.C.S., Rochester, Minnesota
From the Mayo Clinic

FISTULÆ between the bladder and the vagina are the result of difficult parturition, or some operative procedure, most often the extirpation of the uterus for cancer. In the early days most of the cases of fistula that were under observation were the result of trauma at the time of childbirth. It was in the treatment of such cases that Sims developed the first accurate operative technique for their repair. In later years, however, several factors have arisen to change conditions materially. In the first place, better obstetric management has greatly reduced the number of fistulæ which occur as the result of difficult labor, but there has been a great general wave for the radical extirpation of cancer both by operative procedure and by cautery and large doses of radium. While the ultimate results of these operations and treatment warrant the procedure, they very greatly increase the number of cases of vesicovaginal fistula. Sampson, in 1904, reported 19 cases following 158 hysterectomies for carcinoma of the cervix, while a review of the cases in which we have operated since 1908 shows that 61 per cent have resulted from some operative procedure for the removal of tumors of the uterus, and only 39 per cent followed childbirth. These percentages undoubtedly would be different in a strictly obstetric and gynecologic clinic, but they indicate the cause of the fistulæ generally seen.

The occasional satisfactory result of the treatment of a carcinoma of the cervix which is extensive and involves the vaginal mucosa, undoubtedly warrants the continuance of treatment in such cases. The apparent complete disappearance of a large cauliflower cancer of the cervix after a few treatments with radium is most striking, but these treatments should not be undertaken without considering the fact that a fistula from the bladder may result from the use of radium alone as well as from operation or cautery. If the malignancy is eradicated so that the fistula may be repaired satisfactorily the operation is certainly justified, but if the patient is left without control of the urine and with malignancy persisting in the edges of the fistula or evident in other places, the treatment cannot be justified. For this reason the extent of involvement must be studied carefully to make sure that the patient has some chance of relief before the additional risk is taken. Radium has been a great help in the treatment of cancer of the cervix and ordinarily it can be used without the danger of injury to the bladder, although there are 5 cases in our series in which the fistulæ followed the use of radium alone.

The scar resulting from the cautery or radium renders the technique of the operation much more difficult than in the cases which follow childbirth. The scar from the

[1] Presented before the Western Surgical Society, Kansas City, Missouri, December, 1919.

TABLE I. — TYPE OF URINARY FISTULÆ OPERATED ON FROM JANUARY, 1908, TO SEPTEMBER, 1910

Vesicovaginal	67
Vesico-ureterovaginal	6
Vesico uretero uterine	1
Vesico uterovaginal	5
Vesico-urethrovaginal	3
Total	82
Age of youngest patient	19 years
Age of oldest patient	64 years

TABLE II.— CAUSES OF FISTULÆ

	Cases
Childbirth	32 (30 per cent)
Operation	50 (61 per cent)
Hysterectomy	31 (13 in our clinic)
Percy cautery (no hysterectomy)	4 (2 in our clinic)
Excision of cervical stump	3 (0 in our clinic)
Percy cautery and radium for recurring cancer (previous hysterectomy)	3 (2 in our clinic)
Amputation of cervix	2 (0 in our clinic)
Litholapaxy through urethra	2 (0 in our clinic)
Puncture drainage of bladder for cystitis	3 (0 in our clinic)
Abscess drained through vagina	2 (0 in our clinic)
Total	50 17
Shortest time between occurrence and repair	3 weeks
Longest time between occurrence and repair	24 years

use of the cautery is thick and firm, and it is very troublesome to free the tissues so that the flaps may be approximated and sutured. The flaps tear readily so that care must be taken in forcing the needle through them. The scar resulting from the trauma of parturition is much smaller and the tissues are much more pliable and easier to suture.

The apparent ease with which vesicovaginal fistulæ may be closed is deceiving sometimes and, unless definite principles are followed, the results will not be uniformly satisfactory. Too many times, I believe, an attempt is made to close the opening before dissecting the bladder wall well away from the vaginal wall. In some instances it may be possible to close the opening in this manner, but I agree with recent writers on the subject who emphasize the fact that the underlying principle of the technique of the operation is the separation of the wall of the bladder from the wall of the vagina. The condition which keeps the fistula from healing of its own accord is the fact that the mucous membrane of the bladder and vaginal wall have healed together, thus forming a continuous mucous membrane surface from the bladder to the vagina. The first essential in the treatment consists in destroying the communication, and the best manner of accomplishing this is completely to dissect the bladder away from the vagina as is done in the operation for the relief of cystocele. If the mucous membrane of the fistulous tract is not freed so that it can be turned into the bladder on the one side and into the vagina on the other, the communication will almost certainly reform. A review of our cases shows that often several operations have been necessary before the fistula closed permanently. Sixty-eight per cent of our patients had been operated on from one to seven times before coming to the clinic. In most instances these operations had apparently been done well; in others I believe the operator had been deceived into performing an operation by its apparent simplicity. Undoubtedly a certain percentage of these patients require more than one operation, and I believe we are justified in repeatedly attempting to try to close the fistula if the sphincter muscle has not been destroyed. If the urethra and the sphincter muscle are destroyed, there is nothing to be gained in operating to close the fistula as the urine will continue to escape. At times the urethra may be destroyed and the sphincter be intact; in these cases the operation should be performed as the absence of the urethra will not cause any great inconvenience. In other cases the sphincter may be divided or torn by trauma, and there is every likelihood that the sphincter will functionate if it is repaired; therefore operation to close the fistula and repair the sphincter should be done. It seems to me that the operability of these cases depends on whether or not there is a sphincter muscle. Even though it is severed, any number of attempts should be made to repair it before the only other feasible procedure is advised, that is, some plan of diverting the urine to the rectum, thereby leaving it under the control of the rectal sphincter; this may be done if the sphincter of the bladder is completely destroyed. Probably Keen's plan is the best one to adopt in these unfortunate cases, that

is, to make a large communication between the vagina and rectum just above the anal sphincter and then close the vaginal outlet. In Keen's case the woman defæcated and urinated for more than 35 years and menstruated for 11 years by rectum. Peterson collected 41 cases in which this operation was performed with comparative success. In one case only the patient died of a kidney infection and that was some months after the operation; the infection was not believed to be due to the entrance of organisms from the colon to the bladder.

The basis of this review is the 78 cases in which operation was done in our clinic from January, 1908, to September, 1919[1]. In 54 of these cases it was possible to close the fistula at one operation; in 16 two operations were performed, and in 1 six operations failed completely to close the fistula. The fistulous opening in these cases varied from the size of a small pin-point to complete eversion and prolapse of the bladder. Complete prolapse of the bladder into the vagina occurred in 2 cases, one following childbirth in which several operations had formerly been done, and one following combined cautery and radium treatment for cancer of the cervix. In the first case the fistula was repaired successfully, but in the second case the repair was not complete; the entire anterior part of the rectum had been destroyed by the use of the cautery, and it was impossible to keep the field of operation clean.

In 75 cases the fistulous opening was single; in the other 3 cases there was more than one opening. The multiple fistulæ did not offer any more difficulties than the single. A large incision in the vaginal wall included all the openings and converted the operation into a single closure after the openings into the bladder had been separately closed.

The bladder sphincter was involved in 10 cases, but it was destroyed in only 3; it was repaired quite satisfactorily in the 7 cases.

One of the ureters was involved with the vesical fistula in 6 cases. I believe that it is very important to determine the relationship of the ureters whenever it is possible. In a few instances the opening of the ureter was found close to the edge of the fistula and it was possible to turn it into the bladder, or at least avoid injuring it. In several of the cases in which the ureter was involved the suprapubic operation was performed; the ureter was transplanted if it appeared to be in good condition, and the opening of the vesical fistula closed. In one of these cases the ureter was thickened and evidently had been completely occluded for a long time so that it seemed advisable to ligate it.

In all cases in which the suprapubic operation was selected, it was selected for some special reason; it was not employed generally in vesicovaginal cases. The patients on whom the suprapubic operation was performed have all done well, and their convalescence was more favorable than might have been expected. While the suprapubic opera-

TABLE III.—Operations Elsewhere

Repair attempted before coming to clinic in....	44 cases
13 patients had had 1 operation.	
15 patients had had 2 operations.	
6 patients had had 3 operations.	
4 patients had had 4 operations.	
3 patients had had 5 operations.	
2 patients had had 6 operations.	
1 patient had had 7 operations.	
No previous operation for repair of the fistulæ	38 cases

TABLE IV.

Patients operated on in the clinic.....	78
54 patients had 1 operation.	
16 patients had 2 operations.	
4 patients had 3 operations.	
1 patient had 4 operations.	
2 patients had 5 operations.	
1 patient had 6 operations.	
Inoperable recurring carcinoma of the bladder ruled out, plastic operation in.....	4 cases

The fistulæ varied from a very small opening to complete eversion and prolapse of the bladder.

TABLE V.—Extent of Involvement

Bladder sphincter.....	10 cases
Bladder sphincter completely destroyed.....	3 cases
Ureter.....	6 cases
Single fistulæ.....	79 cases
Multiple fistulæ.....	3 cases

TABLE VI.—Type of Operation

Plastic closure: Layer suture; dissection of fistulous tract and closure; inversion of edges by tension through meatus.....	69 cases
Suprapubic operation.....	5 cases
Transplantation of the ureter.....	3 cases
Ureter ligated.....	1 case

[1] I am greatly indebted to Dr. R. G. Andres for his careful study of our case records and the resulting data.

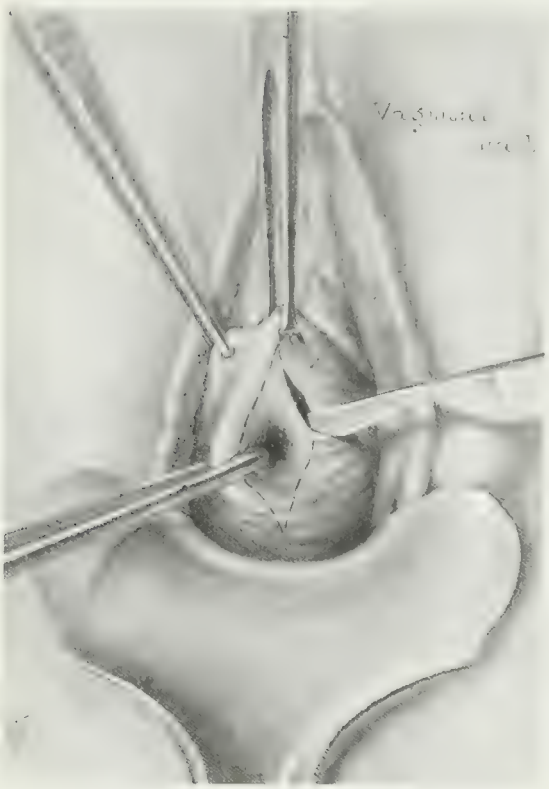

Fig. 1. Dotted line indicating area around fistula to be incised.

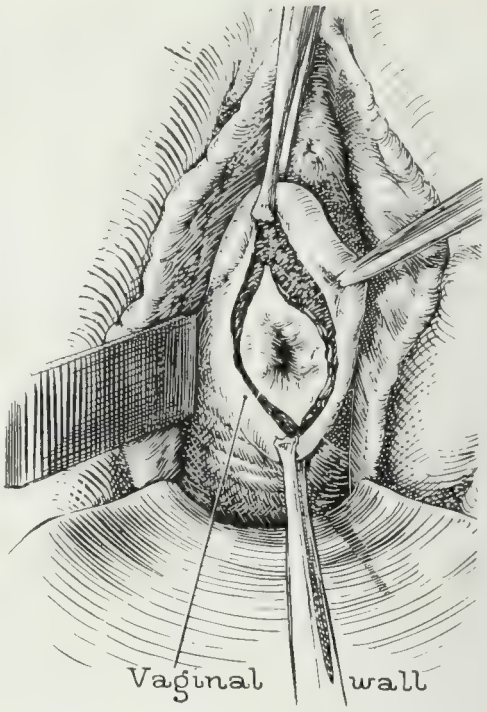

Fig. 2. Incision completed and vaginal wall retracted.

tion offers a good chance for cure, it also offers a greater opportunity for infection, and should not, therefore, be chosen unless especially indicated. Our suprapubic operations were performed extraperitoneally.

Trendelenburg is credited with having performed the first suprapubic operation for vesicovaginal fistula in 1890, and, according to Ward, 27 such operations were reported within the next 14 years. Fewer operations have been reported during the past 15 years, probably on account of the added risk of infection.

Legueu has recently advocated the transperitoneal vesical route for operation in cases of vesicovaginal fistula. One of his 12 patients operated on by this method died. He claims, for this method, wide exposure and every security for healing since in making closure the bladder incision is covered by peritoneum. Such suprapubic operations undoubtedly should be carried out in some of the very bad cases, especially if the ureter and bladder are traumatized. In certain instances the fistulous tract becomes attached to the pubic bone and is thus held in a most inaccessible position, making closure difficult by the vaginal route. In some of these cases the suprapubic operation can be used to advantage.

In most instances cases of vesicovaginal fistula can be dealt with satisfactorily by making plastic closure of the fistulous openings through a vaginal incision. If the opening is small the technique described by C. H. Mayo may be followed, that is, inverting the fistula into the bladder. The inverted fistula is held in the bladder by tension on the purse-string suture which is pulled out through the urethra.

Dr. Crenshaw, of our staff, has closed a number of small vesicovaginal fistulæ by the use of the high frequency current. If the fistula is small it is well worth while to try this method before attempting an operation.

Before any operation is undertaken, an effort must be made to get the tissues in the

Fig. 3. Dissection of the wall of the vagina from the wall of the bladder.

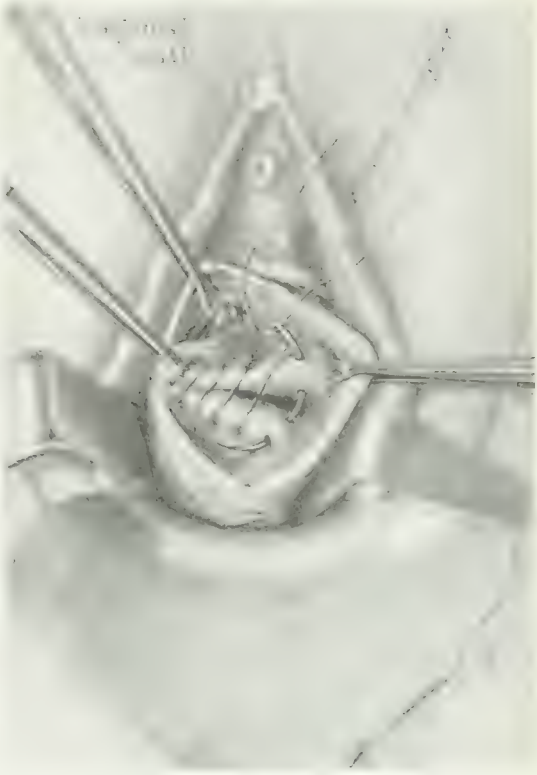

Fig. 4. Suturing the wall of the bladder.

best possible condition for healing. This frequently requires several weeks since often the mucous membrane of the vagina, the labia, and even the skin of the thighs are excoriated and infected, and contain deposits of salts. A cystoscopic examination should always be made in order to determine the position of the ureters, the presence or absence of a sphincter muscle, and whether or not the bladder is completely severed from the urethra. One of the greatest difficulties encountered is trauma to the vesical neck. The vaginal operation certainly should be chosen in all cases of injury near the neck of the bladder, the part difficult to expose by suprapubic incision, so that in such injuries this incision would be distinctly contra-indicated. If the opening in the bladder is high in the vaginal fornix and especially if there is much scar tissue, as there is apt to be following cautery or total hysterectomy, it will be difficult to obtain sufficient exposure by vaginal incision, and in some instances it may seem best to perform the suprapubic operation. The fistula can usually be made accessible, however, so that the operation may be done through the vagina. Very often the perineum is badly torn, and incision into it for exposure is not necessary, but if the incision is necessary it should be made unhesitatingly, and the openings closed at the completion of the operation. One of the chief steps in this procedure is a long incision in the vaginal wall down to the bladder. Usually the incision is begun immediately below the sphincter muscle and extended to and through the fistulous opening, after which the bladder is separated from the vagina for a considerable distance (Fig. 1). I have found it easier to begin this dissection as near the cervix as possible and to bring it forward toward the urethra. Unless this step is thoroughly carried out, the chance for a cure is not good. If the

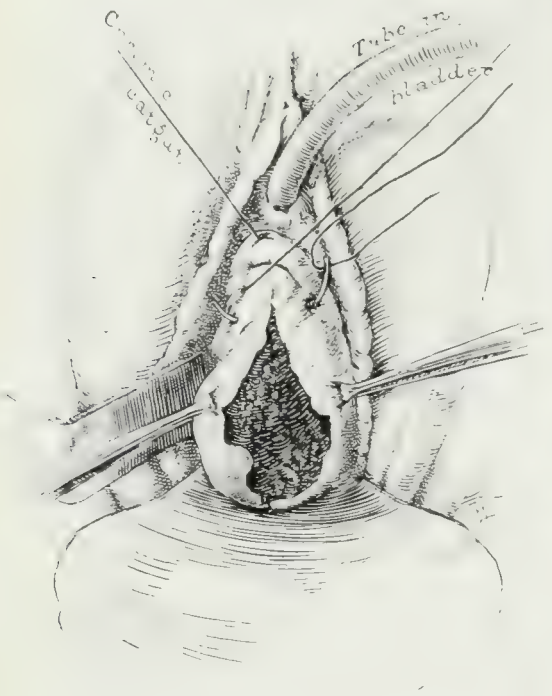

Fig. 5. Suturing the wall of the vagina.

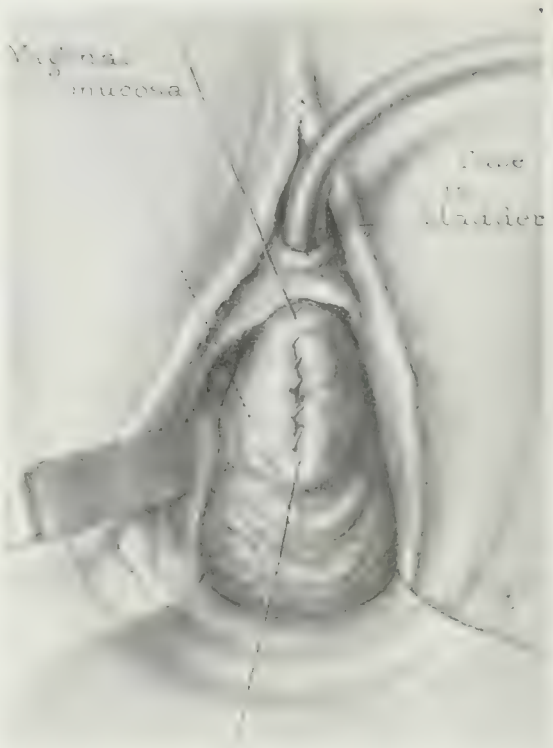

Fig. 6. Closure of the wall of the vagina.

cervix has not been removed, downward traction should be exerted upon it as this helps materially in the exposure (Fig. 2). If the cervix has been removed and the fistula is high in the vagina, it may be best to open the peritoneum widely in order freely to mobilize the bladder and bring the fistula into view. Several years ago Kelly suggested opening the peritoneum and I have followed this method a number of times to great advantage. It must be remembered that loops of intestine are usually caught in this scar and are apt to be injured. This accident happened in one of my operations, but I was able to repair the opening in the intestine without much trouble. Ordinarily I do not believe that it is necessary to open the peritoneum, but in almost inaccessible cases it is helpful. Slight infection may follow, although it was not a complication in my cases. In one case in which I did not open the peritoneum the patient developed a fæcal fistula through the vagina, and I was obliged to repair it by abdominal procedure.

A small curved hæmostat passed through the urethra and into the vagina through the fistula has helped us most to bring the fistulous tract downward into the dissection. The dissection of the bladder should be carried on until the wall is loose and free and until the edges can be easily approximated (Fig. 3). In the cases of extensive injury this is sometimes impossible and it then seems best to close the bladder opening as completely as possible without using tension on the sutures; complete closure can be made later. If too much dissection and tension is employed the circulation to the flaps will be reduced, and sloughing of the tissues will occur. Fortunately many of the tissues may be separated without harm. It is better to perform two or three operations than to carry the procedure too far at one time. The opening in the bladder should be closed with catgut and the edges of the mucous membrane inverted (Fig. 4). The vaginal incision should be closed with chromic catgut and all dead space between

the bladder and vagina obliterated (Figs. 5 and 6). In case the sphincter has been repaired or the urethra sutured back to the bladder it is best to use fine silk sutures in addition to the catgut, being cautious not to penetrate the mucous membrane with the silk.

A retention catheter is left in the bladder for from 8 to 10 days, and great care must be taken to make sure that it drains properly. Patients should be kept quiet for from 12 days to 2 weeks.

There was no mortality in this series of cases, and the ultimate results were very satisfactory in a large percentage. We have recently received information concerning 56 of the 78 patients. Four state that they have derived no benefit from the operation; 6 are considerably improved, although there is still slight incontinence of urine. All the other patients are completely relieved and the bladder function is normal.

In conclusion I wish to emphasize points as follows:

1. Vesicovaginal fistulæ are now more common following operations than following childbirth.

2. All vesicovaginal fistulæ should be considered operable as long as the sphincter muscle of the bladder is intact or can be repaired. If the sphincter has been completely destroyed it will be necessary to consider some other procedure.

3. Suprapubic extraperitoneal operations seem to be indicated if the cystoscopic examination reveals injury to a ureter as well as to the bladder, or it may be indicated if the fistulous tract is adherent to the pubic bone.

4. The plastic vaginal operation consists in completely separating the bladder from the vagina, and closing the two separately and obliterating all dead space.

5. A large percentage of complete and permanent cures follow such operations.

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A CONGENITAL ANOMALY OF THE DUODENUM AND ITS SURGICAL SIGNIFICANCE[1]

By LEONARD FREEMAN, M.D., F.A.C.S., Denver, Colorado

IN operating upon the stomach for supposed occlusion of its outlet, especially before the extensive use of the roentgen ray, surgeons occasionally were puzzled by finding a dilated pylorus and duodenum instead of a stenosis. Considerable time elapsed before it was recognized that partial chronic obstruction of any portion of the intestinal tract might result in "backing-up" of the contents of the bowel upon the stomach, giving rise to stenotic and other gastric symptoms and possibly duodenal ulceration. I am convinced that this important fact is not kept in mind as clearly as it should be, thus leading to the overlooking of conditions that could be corrected if searched for intelligently.

Among a multitude of possible obstructive lesions are those occurring at the duodenojejunal angle. It will be remembered that Lane described a "kink" sometimes existing where the fourth portion of the duodenum appears from beneath the root of the transverse mesocolon to the left of the spine, to merge into the jejunum. The duodenum is here ascending and fixed, owing to the absence of a peritoneal covering; while the jejunum is descending, enveloped in peritoneum, and free, thus giving rise to the normal duodenojejunal angle (Fig. 1).

Occasionally, a peritoneal fold from the colonic mesentery (ligament of Treitz) pulls on the jejunum and increases the normal angulation until it becomes pathologic, the condition being perhaps aggravated by contracting bands. It is obvious that when once recognized the difficulty can be corrected by dividing this fold, which is readily done because of its accessibility.

I wish to describe another form of duodenojejunal kink, depending upon the persistence of an embryonic condition.

It will be recalled that the adult normal duodenum swings in a somewhat angulated loop from the pylorus downward to the right of the spine, passing beneath the hepatic colon to its pelvic side. It then runs directly across the spine, beneath the superior mesenteric vessels and the mesentery of the small intestine and finally ascends obliquely toward the left to join the jejunum at the base of the transverse mesocolon.

During early fœtal life, and in certain lower animals, the entire duodenum is covered by peritoneum and possesses an individual mesentery; but later the terminal three-fourths loses its peritoneum, becomes fixed in fibrous tissue, and attaches itself to the root of the transverse mesocolon, to the left of the median line, at the duodenojejunal angle. This attachment ("duodenal fold") occurs early and is quite constant.

In the anomaly under consideration, the duodenum, after passing beneath the colon, travels, as it were, too far toward the pelvis, thus bringing the transverse portion an unusual distance below the mesocolon. In addition, after passing beneath the colon, it does not become subperitoneal, as it should, but lies free in the abdominal cavity, with a peritoneum and mesentery of its own, as in the fœtal state just mentioned. But in spite of this freedom, the duodenojejunal angle often remains firmly attached on the left to the root of the mesentery of the transverse colon by the duodenal fold, thus suspending the intestine and possibly kinking it at the point of suspension (Fig. 2). A certain amount of twisting of the bowel may contribute to the tendency to obstruction, as may likewise the inclination of the root of the mesentery of the small intestine to push downward the free duodenal loop, especially if filled.

The peculiarity is of course congenital, but we may assume that it can increase with age, because of thickening and contraction of the suspending ligament, until partial obstruction finally appears. This leads to hypertrophy and dilatation of the duodenum, with stagnation of its contents, and eventually to widening of the pylorus and alterations in the stomach.

[1] Read before the Western Surgical Association, Kansas City, December 6, 1919.

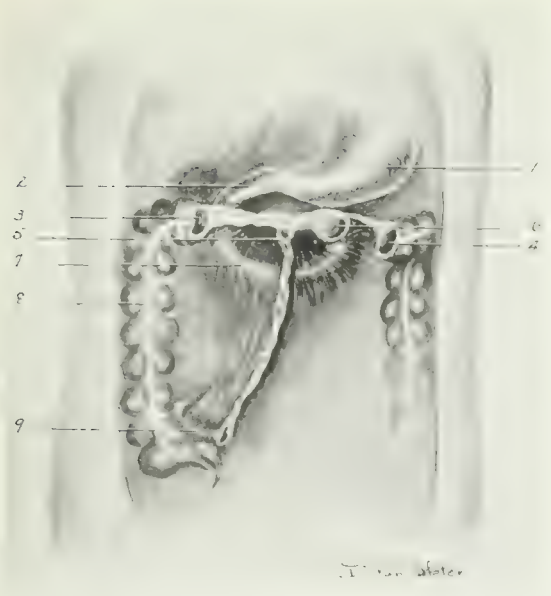

FIG. 1. *1*, stomach; *2* and *7*, duodenum; *3* and *4*, severed ends of transverse colon, removed to show root of mesocolon; *5*, mesentery of small intestine; *6*, duodenojejunal angle; *8*, ascending colon.

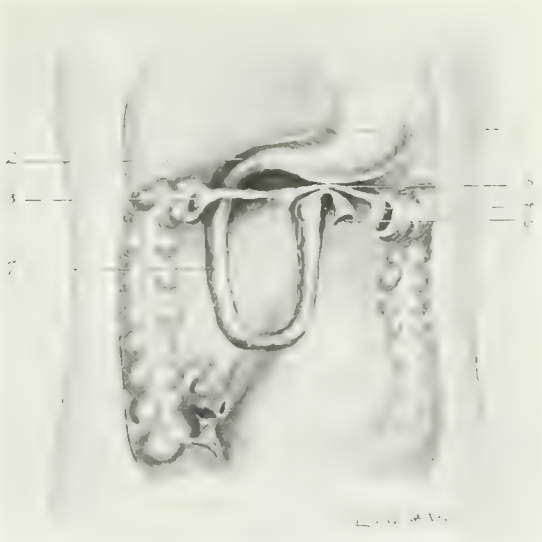

FIG. 2. *1*, stomach; *2*, first portion of duodenum; *3* and *4*, severed ends of transverse colon, removed to show root of mesocolon; *5*, "kink" at duodenojejunal angle; *6*, jejunum; *7*, free duodenal loop (length exaggerated in drawing) passing beneath mesentery of small intestine.

The symptoms so closely resemble those of duodenal ulcer with pyloric obstruction that a correct diagnosis is hard to make without help from the X-ray, and even then certainty is not apt to be obtained short of an exploratory incision. In operating, however, it is important to bear the possibility of the trouble in mind, for "what we don't think of we may not see."

The surgical treatment may be difficult because of certain more or less awkward complications.

1. The lesion is deeply situated, being due to a firm adhesion pulling the gut down to the root of the colonic mesentery, the embarrassment often being further increased by the location of the incision, which is usually to the right of the spine, while the kink is to the left.

2. The inferior mesenteric vein and left colic artery lie just external to the kink and might be injured if care is not exercised. Hence one should cautiously strip the peritoneum bluntly from the surface of the bowel, rather than attempt to divide the ligament with knife or scissors, taking care that the gut is not perforated during the manipulation.

3. The completion of the procedure exposes a raw intestinal surface which may be quite large, and requires attention in order to prevent troublesome adhesions. Sometimes the edges of the torn peritoneum can be so stitched together as to cover the denuded area without compromising the lumen of the bowel; occasionally it may be desirable to use a free omental graft, as I have done in one instance.[1]

Since my attention has been called to this subject I have operated upon six of these duodenal obstructions. In no one of them, in spite of the X-ray, was the diagnosis made previous to the operation, the real trouble being discovered only after a lesion near the pylorus had been excluded.

SUMMARY

Partial occlusion of the duodenum at the duodenojejunal angle, simulating pyloric obstruction, occasionally occurs from the persistence of a condition normally existing in fœtal life. In this, the duodenum, instead of appearing in the abdominal cavity from beneath the transverse mesocolon to the left

[1] Dr. C. U. Collins has short-circuited the obstruction by anastomosing the ascending portion of the duodenal loop to the jejunum when occasionally may be advisable.

of the spine, as it should, emerges to the right, its transverse and ascending portions possessing a peritoneal covering and mesentery of their own, similarly to the rest of the small intestine, instead of being fixed in fibrous tissue, as is normally the case. At the duodenojejunal angle, however, the bowel is hung up to the root of the colonic mesentery by a firm adhesion (duodenal fold of fœtal life), the "kink" thus produced being intensified by the downward pull of the free duodenal loop. This kink is deeply situated and in freeing it care must be taken not to injure the bowel, the inferior mesenteric vein or the left colic artery. A considerable denudation of the gut may be necessary, which should be covered either by reuniting the peritoneum or by means of a free omental graft.

ENDO-ANEURISMORRHAPHY[1]

I. Statistics of Operation of Endo-Aneurismorrhaphy

II. Personal Experiences and Observations on the Treatment of Arteriovenous Aneurisms by the Intrasaccular Method of Suture with Special Reference to the Transvenous Route[1]

By RUDOLPH MATAS, M.D., LL.D., F.A.C.S., New Orleans

STATISTICS OF OPERATION OF ENDO-ANEURISMORRHAPHY

AT different times I have published detailed statistics of the operation of endo-aneurismorrhaphy in all its phases, the first systematic description being given in the *Transactions of the American Surgical Association*, in 1902, which included the first case operated upon by my method, dating back to March 30, 1888. The most complete report was presented before the International Medical Congress, London, August, 1913, in which was included a detailed and classified account of 225 cases. This report was buried in the transactions of the congress and therefore received but little publicity. The list of operations and results up to December 31, 1915, presented at the Muetter Lecture, Philadelphia, increased the number of reported cases available for statistical purposes, to 289. The diversion of professional interests created by the world war suspended the further collection of statistical material. Nevertheless, I have been able to add 28 new cases (chiefly personal and American) from July 1, 1916, to September, 1919, increasing the total list to 317 cases.

It has given me much pleasure to find that the method of intra-aneurismal suture has been found very satisfactory in the treatment of war aneurisms, both arterial and arteriovenous in the cases in which it has been applied. The method has been used by many foreign surgeons in the belligerent armies, who, though applying the intrasaccular suture on the principles which I and my co-workers, have long advocated, have not always given credit to its American, or even its antebellum origin. I regret that in spites of the numerous articles published, a lamentable ignorance is displayed, especially by foreign writers in regard to the underlying principles and simple technique of the methods of intrasaccular suture embraced under the term endo-aneurismorrhaphy. I feel that it is due my many friends and to the contributors to the

Note.—The spelling of the word "endoaneurismorrhaphy" as given in this article is in accordance with the classical orthography of the dictionaries. In revising the proof, Dr. Matas writes that he regards this spelling of the word as archaic and has personally abandoned it in favor of the contracted word "endoaneurismoraphy" which is equally descriptive and faithful to its Greek origin, but much simplified by the elimination of unnecessary consonants in accordance with the rules of the Carnegie Spelling Board.—Editor.

[1] This article is a summary of an original paper read by Dr Matas before the Southern Surgical Association (in New Orleans, December 16-18, 1919), upon (1) "Personal Experiences and Observations on the Treatment of Arteriovenous Aneurisms by the Intrasaccular Method of Suture, Endo-Aneurismorrhaphy, with special Reference to the Transvenous Route," and (2) a summary of "Statistics of the Operation of Endo-Aneurismorrhaphy," and is a discussion of a paper by Dr. Gaston Torrance on "Femoral Aneurism."

statistics of the operation that some account of the statistical progress be made. To this end a tabulated summary of the unpublished report which I presented at the Muetter Lecture in Philadelphia is given. This report does not include the group of cases which have accumulated since that date and to which I shall briefly refer after reading the table.

The total number of cases of endo-aneurismorrhaphy reported up to December 31, 1915, at the Muetter Lecture, Philadelphia, including the 225 previously reported at the International Medical Congress of London, August 1913, is shown in Table I.

TABLE I

Total cases up to December 31, 1915	289
Eliminating 6 cases of fatal inoperable aortic aneurisms and 2 accidental deaths, leaves a total of	283
Deaths	13, or 4.5 per cent
Operative cures and recoveries	270, or 95.4 per cent
Cases of gangrene	12, or 4.2 per cent
Secondary hæmorrhages	6, or 2.1 per cent

Of 289 operations there were of the

	Cases	Per Cent	Deaths	Per Cent	Gangrene	Per Cent
Obliterative type	193	66.8	10	5.8	9	4.6
Restorative type	65	22.5	2	3.0	1	1.5
Reconstructive type	31	10.7	1	3.2	2	6.4

These operations cover all the large surgical arteries, including the abdominal aorta. Fully 86.1 per cent involve the arteries of the lower extremity, including the external iliac; of the popliteal aneurisms there were 154 cases, or 53.2 per cent; of femoral aneurisms, 61 cases, or 21.1 per cent, of the whole. If the popliteal group is selected as one of the most certain tests for all aneurism operations, we find that it has been performed in all the three types of endo-aneurismorrhaphy, 154 times. Of these, 103 were obliterative operations followed by 6 cases of gangrene, or 5.2 per cent; 2 secondary hæmorrhages, or 1.3 per cent; 2 relapses in the reconstructive group or 1.3 per cent, one of which was cured by a secondary obliterative suture. In the 154 popliteal operations there was only one death, or 0.6 per cent mortality, and 8 cases of gangrene, or 5.2 per cent. The total number of failures from all causes, including the 8 cases of gangrene, was 10, or 6.4 per cent. Five cases of gangrene occurred after the obliterative operation, 1 in the restorative group, and 2 in the reconstructive. The total recoveries as to life were 143, or 99.3 per cent, and the total operative successes as to cure of the aneurism with good functional results as to life and limb, 93.6 per cent.

The results obtained by combining all the operations performed on the aneurisms of the lower extremity, including the external iliac, iliofemoral, femoral, popliteal and tibials, were, up to January 1, 1916, in 246 cases, 230 cures and 16 failures, or 6.5 per cent from all causes. Since January 1, 1916, up to September, 1919, the author records 28 additional cases, exclusive of a considerable number of operations performed during the war by foreign surgeons which have not been tabulated. Of these 28 endo-aneurismorrhaphies, 17 were obliterative, 7 restorative, and 4 reconstructive. In these groups are included 7 aneurisms of the neck and upper extremities, 5 femoral, 16 popliteal, with 1 death which happened in an exsanguinated subject, operated upon *in extremis*, after rupture of an aneurism. There were no cases of gangrene. There was one case of secondary hæmorrhage following a catgut suture, cured by an obliterative operation with silk. These additional cases increase our total collective list to 317 endo-aneurismorrhaphies up to September, 1919, of which 81 were performed in New Orleans and in the state of Louisiana, including 46 operations by the writer. These do not include 19 carotid, subclavian, innominate, iliac, and iliofemoral aneurisms, and cervical tumors requiring the extirpation of the common carotid, which were treated by the writer on the Halsted principle, either with the adjustable Matas-Allen aluminum band, applied proximally in the continuity of the vessel on the Hunterian plan, or by combining the band with the direct suture of the arteriovenous communication by the transvenous route. In all of these, complete operative cures were obtained, with the exception of 2 deaths from intercurrent or accidental complications (coronary heart disease and mesenteric thrombosis). These 19 cases do not include 16 additional applications of the band distally, or on the Brasdor plan, to the common carotid and subclavians, either simultaneously or consecutively, for the palliation of advanced aortic and innominate aneurisms, in which decided relief was obtained in approximately 30 per cent of the cases. At this

meeting 4 cases of endo-aneurismorrhaphy were added by Gaston Torrance, of Birmingham, Alabama; 4 by A. C. Scott, of Temple, Texas; 1 by Shelton Horsley, of Richmond, Virginia; and 1 by C. C. Coleman, of Richmond, Virginia—in all 10 successful cases, which increases the total number to 327 cases operated upon by my technique.

PERSONAL EXPERIENCES AND OBSERVATIONS IN THE TREATMENT OF ARTERIOVENOUS ANEURISMS BY THE INTRASACCULAR METHOD OF SUTURE, ENDO-ANEURISMORRHAPHY, WITH SPECIAL REFERENCE TO THE TRANSVENOUS ROUTE

In the preceding pages the surgical cure of arterial aneurisms by intrasaccular suture has been discussed. Now I desire to call attention to the advantages of the principles of endo-aneurismorrhaphy as applied to arteriovenous lesions.

The records of the world war have not only confirmed the experience of military experts that the coincident injury of the arteries with their satellite veins is one of the most frequent and characteristic injuries of the blood vessels in modern warfare, but they have shown that such injuries have exceeded the number in any previous war. At the front, 24.7 per cent of the wounded required special attention for injuries of the blood vessels, and at the base hospitals 2 per cent of the wounded were admitted for the treatment of traumatic aneurisms. This was due to the unprecedented preponderance of artillery and machine-gun fire. Of these vascular injuries fully 50 per cent and more involved both the artery and vein. The methods of treatment varied with the different belligerents. The Germans preferred to treat their cases by either lateral or circular suture, the French by extirpation and quadruple ligation, and the British usually by quadruple ligation with or without extirpation. While the Germans advocated early operations, within the first 3 weeks, the Allies delayed all operations, especially in arteriovenous lesions, until the collateral circulation had time to become fully established. In the last years of the war, the British and French reports showed a more frequent application of the suture, but still these cases were in the minority.

There is no single method of technique that is applicable to all varieties of arteriovenous aneurisms as these are met in practice. Some few of these aneurisms are susceptible of spontaneous cure; some are wonderfully well tolerated and do not call for any surgical treatment whatever, and still a few others, of long standing, are of such a forbidding character that they scarcely justify any surgical intervention whatever. The large majority, however, ultimately come to operation on account of disabling sequelæ and complications. The modern operations should always aim at conservatism. The operator should always approach these cases with the intention of at least saving the artery. There are, however, and always will be, cases in which the conservative principle of suture, which aims at the restoration of the functional integrity of the blood vessels, will have to yield—in the presence of insurmountable and forbidding anatomical and pathological obstacles—to the radical methods of ligation and extirpation, which are also to be regarded as conservative whenever they accomplish their purpose (cure) with the saving of limb and life.

But the experience of the author has proved to him that by the adoption of new technical suggestions, such as exhibited in this paper, the opportunities for the application of a conservative suture technique can be much enlarged, thereby reducing very considerably the number of radical ligations and extirpations which have been undoubtedly performed with unnecessary frequency and severity in the past, not only in recent military practice of this war, but in the current civilian practice of the day.

In reviewing the anatomy or morphology of arteriovenous aneurisms, I wish to call attention to several erroneous conceptions that are still found in the textbooks in regard to so-called varicose aneurisms. The old classical idea that an intermediary pseudo sac is interposed between the artery and the vein is an exceptional finding and not the rule. The wounded vessels are usually not detached or separated, their contiguity or parallelism

is not disturbed and the adventitious sac which communicates with the vessel is placed either in front or behind them, and only exceptionally between them.

The most frequent arteriovenous lesion is the aneurismal varix (varix aneurismaticus) the simple "phlebarterie" of Broca, in which contiguous vessels communicate by a direct arteriovenous fistula. These constitute more than 50 per cent of the cases in war and in peace; and this is fortunate from the operative point of view, because they are most easily cured by the simple closure of the orifice of communication through the vein. The method of approach by the transvenous route (Matas-Bickham procedure) accomplishes the one essential for the cure of arteriovenous aneurisms; viz., the complete exclusion of the arterial from the venous lumen, and thus restores the two blood streams to their normal channels, with the least disturbance and the minimum trauma.

This method of curing aneurismal varices is a direct derivative of the method of endo-aneurismorrhaphy in its restorative type, as applied to arterial aneurisms, in 1902, but which I practiced as far back as March 30, 1888. The application of the endo-aneurismal suture to arteriovenous aneurisms was first suggested and described by the author's friend and former associate, W. S. Bickham, now of New York, in a well-illustrated paper published in the *Annals of Surgery*, for May, 1904, and was again presented in all its phases in Bickham's *Operative Surgery* (3d ed., 1908) under the heading: "Operations for the radical cure of arteriovenous aneurisms, with preservation of circulation in the artery and vein (Matas-Bickham operation)."

In a personal experience of 205 surgical interventions upon the large vessels, I have recorded 24 cases of arteriovenous injuries of different types, in which I have used various methods of treatment. In this group the principle of endo-aneurismorrhaphy was used in 12 cases, viz., common carotid, 1; external iliac, 1; common and superficial femoral, 8; peroneal vessels, 1; subclavian, 1. In all of these the intrasaccular suture was applied to obliterate the orifice of communication, either by suturing all the orifices communicating with the pseudo sac in varicose aneurisms, or, in aneurismal varices by opening the sac formed by the dilated vein, and closing the fistula on the venous side (intravenously). This procedure was followed by the ligation of the vein and its obliteration immediately above and below the sutured anastomosis; or by detaching the vein from the artery after the obliteration of the orifice of communication had been accomplished by intravenous suture. The first clinical application of the transvenous route as a means of closing an arteriovenous fistula in the femoral vessels, on the Bickham-Matas principles was done by H. B. Gessner, the author's associate, on May 30, 1908. J. Chalmers Da Costa, of Philadelphia, cured a popliteal varix by the same procedure, with same modifications, in October, 1910. The author followed in a formidable case of jugulocarotid aneurism of 15 years' standing, in 1912, though he applied the suture to arteriovenous lesions by other methods as early as 1900. Then followed a number of other cases, in his practice and that of his associates, which gave him added opportunities to satisfy himself of the great technical value of the transvenous route in dealing with aneurismal varices, and of the intrasaccular suture in the so-called varicose variety.

The war with its vast opportunities for the development of the resources of vascular surgery, has yielded a comparatively small number of cases in which the transvenous route has been successfully utilized for the treatment of aneurismal varices. (Pearson, of Dublin, 1916; LeFort, Paris, 1917; Lecéne, Paris, 1917; and a few British surgeons mentioned by Sir George Makins, including his own cases, in his recent and excellent monograph on *Gunshot Injuries of the Blood Vessels*, 1919.) All of these observers extol the method for its simplicity and efficiency. Makins gives the transvenous route his unequivocal endorsement as the best method of curing pure aneurismal varices. All these writers seem to have come to the realization of the simplicity and value of this method rather late in their war experience, and with the exception of Lecéne and Forgue do not appear to be aware of its antebellum or American origin.

THE TREATMENT OF DUODENAL FISTULA

By STUART McGUIRE, M.D., F.A.C.S., Richmond, Virginia

THE increase in surgery and the more radical work now being done in the upper right abdomen has undoubtedly been attended by the production of many cases of traumatic duodenal fistula. While the aggregate number is large, no considerable number has developed in the practice of any one surgeon, hence very little has been written on the subject. This is to be regretted as the condition is a serious one and the best method of dealing with it has not yet been clearly settled.

A duodenal fistula usually follows an operation on the duodenum or an injury to the duodenum in the course of an operation on the gall-bladder or kidney. Such fistulæ sometimes develop immediately but more often are first noted 4 or 5 days after an operation at a time when the patient is supposed to be out of danger. This is due to stitches giving way or to tissue strangulated by a ligature or forceps undergoing sloughing. The discharge of duodenal and stomach contents may begin gradually and be small in amount, or it may begin suddenly and comprise all liquids and food taken by mouth and all the secretions of the stomach, liver, and pancreas. If the fistula is small and the discharge is scant the opening may close spontaneously and the patient recover, but usually the destructive action of the digestive secretions causes the fistula to enlarge, and unless there is surgical intervention the patient dies. The excoriative effect of the discharges on the wound and adjacent skin, the inability to retain nourishment taken by mouth, and above all the rapid loss of body fluids causes the patient to lose strength and weight in an alarming way. Often in a few hours the facial expression is so changed and the tissues of the body are so shrunken that it is difficult to realize that it is the same individual.

There are few conditions in surgery that require more courage and wisdom properly to meet; courage because a prompt operation must be done under unfavorable conditions on a patient who is thought to be safely convalescent, and wisdom because the best surgical procedure is not settled and different methods have to be adopted to meet different indications.

If the discharge is small or moderate in amount and the patient's general condition is good the fistulous opening may be plugged with gauze, little or no food or drink given by mouth, and the patient sustained by nutritive enemata with the hope that the opening in the duodenum may heal spontaneously. This conservative plan of treatment should not be continued if the patient loses strength rapidly, but more radical measures should be resorted to before it is too late.

Direct attack and suture of the opening in the duodenum is feasible in some cases but is hopeless in others. If the fistula has followed a nephrectomy and is due to injury inflicted on the posterior wall of the bowel, then the plan suggested and practiced by W. J. Mayo is the logical one. The abdomen should be opened by an upper right rectus incision and the duodenum exposed by retracting the gall-bladder and liver up and drawing the hepatic flexure and transverse colon down. An incision is then made through the peritoneum to the outer side of the duodenum and the bowel carefully separated from its posterior attachment. When the fistulous opening is exposed it can be easily and securely sutured.

If the fistula is on the anterior wall of the duodenum and has occurred as a complication after an operation on the gall-bladder or stomach, the conditions render an attempt at direct closure almost hopeless. The presence of infection makes manipulations dangerous, the existence of adhesions makes exposure difficult, and the inflamed and necrotic state of the bowel wall makes satisfactory coaptation with sutures impossible.

Deaver and others have dealt with the condition just described by doing a posterior gastro-enterostomy with or without closure of the pylorus. This side-tracks the opening in

the duodenum and prevents the escape from the intestinal tract of fluids taken by mouth. The operation is especially advisable when the fistula is the result of an ulcer of the duodenum, as it not only meets the immediate indications but also eventually cures the primary disease. It is an operation of some magnitude, however, and cannot be done without risk on a seriously ill patient, and it results in an anatomical abnormality that is to be regretted in many cases.

Recently I had a large duodenal fistula suddenly develop in a woman whose condition was such that a gastro-enterostomy could not be considered. The emergency was met by doing a simple jejunostomy and feeding her by the introduction of food into the intestines at a point below the fistulous opening. The procedure may not be original but I can find no reference to it in the superficial examination I have been able to make of the literature of the subject, and I have therefore decided to report the case.

Mrs. B., age 32, entered St. Luke's Hospital, July 21, 1919. She was very much emaciated, deeply jaundiced and had pulse and temperature indicating septic infection. She said that 8 months before admission she had a sudden attack of abdominal pain that was shortly followed by jaundice which had persisted with little or no variation. Four months ago she had been subjected to an operation, but the surgeon had not been able to locate and relieve her trouble. He told her that he found and separated many adhesions about the liver but that he could not palpate a stone, and therefore did not open the gall-bladder or common duct.

The patient's general condition made her a bad surgical risk but as it was evident she would die unless she was given relief, an operation was undertaken after acquainting the family with the dangers.

The abdomen was opened through the scar of the old incision in the upper right rectus. As anticipated, dense and widespread adhesions were found which were carefully and systematically separated. A small thick walled gall-bladder containing several stones was finally reached, but in freeing it a hole was torn in the duodenum. As it was thought the opening might prove of use in the course of the operation it was not closed at the time but plugged with a piece of gauze. The common duct was next located. It did not contain a stone and was not dilated as had been expected but was empty and contracted. It was opened and a probe passed down it to the duodenum where it could be seen emerging at the ampulla of Vater. The probe was then passed up toward the liver and a stone was found at the bifurcation of the hepatic ducts. The stone was extracted and there was at once a copious flow of bile. The gall-bladder was removed, the opening in the duodenum sutured with a double row of chromic catgut stitches and the common duct drained by a tube sewed in its lumen with protective gauze and rubber tissue placed about it.

The patient stood the difficult and rather prolonged operation unusually well and her progress for a time was very satisfactory. On the ninth day, however, there was a sudden and profuse discharge of gastric contents through the incision, and it was evident that the catgut sutures in the duodenum had given way and a large duodenal fistula had resulted. Water and liquid food taken by mouth escaped through the wound almost as rapidly as swallowed and the patient's condition soon became desperate. She seemed actually to shrivel and shrink while under observation. It was obvious that something had to be done and done promptly. A direct attack on the fistula was hopeless owing to the condition of the tissues and a posterior gastro-enterostomy with occlusion of the pylorus was hopeless owing to the condition of the patient. The only alternative that suggested itself was a jejunostomy.

Under gas oxygen anæsthesia a new incision was made in the mid-line and the operation done by the technique described by Charles H. Mayo. The initial loop of the jejunum was brought into the wound, a small incision was made opposite its mesentery, and a rubber catheter inserted into its lumen. The catheter was retained in place by a purse-string suture and was infolded in the wall of the bowel for a distance of 2 inches, after the method of Witzel. The omentum was then placed in its normal position so that it lay between the loop of bowel and the anterior abdominal wall and a perforation was made in it through which the catheter was passed before it traversed the abdominal wall to be secured by a suture to the cutaneous surface.

The operation was completed in a few minutes and the patient was given a pint of fluid through the tube before she was removed from the table. The result was immediate and gratifying. All discharge except bile through the drain in the common duct shortly ceased and the patient's general condition rapidly improved. She was given water and nourishment exclusively through the catheter and nothing so introduced escaped through the fistula. At the end of 10 days the drain in the common duct was removed and in 3 weeks the primary incision had spontaneously closed. Feeding was cautiously begun by mouth and as it caused no trouble the tube in in the jejunum was taken out. The second incision closed promptly without leakage and the patient was ultimately discharged from the hospital having been relieved of her symptoms and having gained 20 pounds in weight.

SOME ABDOMINAL COMPLICATIONS OF INFLUENZA[1]

By ALEXIUS McGLANNAN, M.D., F.A.C.S., Baltimore

THE association of abdominal symptoms with the onset of respiratory diseases and the development of abdominal lesions as complications of such diseases occur with frequency sufficiently great to rob them of all claim to novelty.

The influenza epidemic gave an opportunity for extensive study of such occurrences and brought out several reports. I shall not attempt to discuss all the possibilities in this field, but shall comment on a few conditions observed during the epidemic.

Acute abdominal symptoms were present in a large proportion of the cases of influenza pneumonia. We did not note any definite relation between the area of pulmonary involvement and the abdominal symptoms. Acute appendicitis was the lesion most often mimicked, while the symptoms of cholecystitis and ruptured gastric and duodenal ulcer were also noted.

Hall and Dyas[2] suggest that the occurrence of symptoms of acute appendicitis in patients at the onset of influenza or pneumonia may be the result of bacterial invasion of the lymphoid areas of the appendix. As the abdominal symptoms were not persistent and their patients ran the average course of influenza, the process must have been limited to this primary invasion of the appendix.

What influence, if any, this sort of involvement of the lymphoid areas would have on the subsequent history of the appendix is not clear. If any appreciable reaction of the tissues takes place, it would seem to prepare the way for the later development of disease of the appendix. That such a sequel is possible, seems proved by the experience of Hall and Dyas at Camp Logan. They noted a great increase in the number of cases of acute appendicitis coming to operation in the 2 months immediately after the epidemic. The average incidence of appendicitis in the camp was 10.4 per 1000, but during the time mentioned it arose to 44.4 per 1000.

During an epidemic when the thoracic lesions are so emphasized, every one remembers the false abdominal symptoms, and mistakes in diagnosis are rare. Under ordinary circumstances one could easily confuse the symptoms of onset of acute appendicitis and those of pneumonia.

Asserson and Rathburn[3] call attention to the following valuable expedient. The area of maximum pain and tenderness is carefully mapped out. The patient is then directed to hold his breath. As long as the diaphragm is quiet, the referred pain and tenderness remain absent. This point helped us exclude an acute appendicitis in the case of a student, who was brought to the hospital with abdominal symptoms at the time of onset of his pneumonia on the second day of his attack of influenza.

X-ray examination of the chest may be an important aid in diagnosis. In one of our cases the plate indicated an area of consolidation, which could not be made out by physical examination of the chest. The symptoms were those of acute appendicitis, but because of the X-ray findings these symptoms were considered false. The patient went through a typical pneumonia and recovered.

Reginald E. Smith[4] notes that the pain and rigidity in the upper zone are referred along the course of the eighth, ninth, and and tenth intercostal nerves. Less frequently, the eleventh and twelfth nerves have caused the referred pain. On two occasions Smith blocked the eighth and ninth nerves, and the symptoms disappeared. He divides the abdominal complications of influenza into three types of lesions:

1. Acute streptococcus peritonitis, which is hæmatogenous in its origin and often associated with streptococcus endocarditis.

2. Acute dilatation of the stomach, a toxic manifestation.

3. Co-incident acute abdominal lesions.

[2] J. Am. M. Ass., 1919, lxxii, 726.

[3] U. S. N. Med. Bull. No. 1, p. 29.

[4] Lancet, 1919, Mar. 15, I, p. 421.

[1] Read before the Southern Surgical Association, New Orleans, December 16, 1919.

During the epidemic of last year, all complications were small in number, because so many patients died in the first days of the illness as a result of the intense infection.

A hæmatogenous peritonitis of varying extent is one of the commonest abdominal complications of influenza. When this peritonitis is a diffuse one, it is a part of a severe generalized infection and does not give the usual picture of such a peritonitis. Beals, Blanton, and Eisendrath[1], in their report, note that in six such cases coming to autopsy, the diagnosis had been made but once.

Subphrenic abscess and localized peritonitis in the region of the diaphragm could easily be confused with thoracic disease, just as a thoracic lesion may give symptoms similar to those of ruptured gastric ulcer, cholecystitis, or appendicitis.

Reginald E. Smith gives certain points which his experience has shown to be of value in distinguishing between true and false intra-abdominal catastrophies occurring as complications of influenza:

1. Movements of the alæ nasi. In the absence of other signs of thoracic disease, abdominal pain associated with movements of the alæ nasi during respiration, indicates a thoracic and not an abdominal lesion. The movement of the alæ, if not present, can be brought out by slight exertion. Such movements of the nose come only in the latter stages of peritonitis, never early in the disease.

2. Dullness in the flanks never indicates a visceral inflammation or a resulting peritonitis, except in the cases of acute hæmatogenous infection of the peritoneum. In these latter cases, the localized pain and other characteristic symptoms of diffuse peritonitis are lost in those of the severe general infection.

3. The facies is that of influenza, not of peritonitis. The anxiety is lethargic and resigned, not terror-stricken and active. It is of the medical rather than the surgical type.

One of our cases illustrates Smith's second point.

The patient, a young colored woman, was admitted to Mercy Hospital, with an influenza pneumonia. She had a temperature of 102.5° and was expectorating thin, purple sputum. She was intensely toxic and apathetic, but not unconscious. The chest signs were those of bronchopneumonia. The abdomen was distended, there was shifting dullness in both flanks, with muscle spasm in the left upper quadrant. There was no œdema and the urine was free from albumin and casts. Except for this muscle spasm, there were no signs of peritonitis. The patient died about 24 hours after admission. We were unable to secure an autopsy, but it seems reasonable to conclude that the peritoneal exudate was the result of a general infection so overwhelming that the ordinary signs of peritonitis were lost.

Thrombophlebitis. The usual situation of an infectious obstruction of the blood vessels is in one of the veins of the leg. Such a thrombophlebitis of the femoral vein may be the starting point for an occlusion clot which will extend into the vena cava and over into the iliac vein of the opposite side. In addition to this form of abdominal thrombophlebitis, it is known that thrombosis may begin in any branch and involve the cava by direct extension, or that a primary thrombosis of the vena cava itself may occur as a complication of one of the acute infectious diseases.[2] In one case we made the diagnosis of obstruction to the vena cava in the region of the hepatic veins.

The patient was a young white man, who passed through a severe influenza pneumonia. He was markedly cyanosed from the onset, and suffered from girdle-like pains in the lumbar and epigastric regions. The intestines were considerably distended and he was constipated. About the fifteenth day of his illness he developed ascites. The physical signs indicated a considerable quantity of fluid in both flanks. The epigastric pain continued and there was slight tenderness just to the right of the vertebræ in the upper quadrant of the abdomen. There was persistent rise of temperature to about 102°. The skin of the abdomen and back was purple red in color. The patient gradually recovered. The fluid was slowly absorbed, and the circulation in the skin gradually became normal.

In this case collateral circulation must have been established by the deep channels as in the case reported by Andrew[3].

Coincident abdominal lesions include the perforative inflammations of the hollow viscera. In studying the cause of these perforations the case reported by Crowley[4] is worthy of

[1] J. Am. M. Ass., 1919, lxxii, 552.

[2] J. H. Pleasants. Johns Hopkins Hosp. Reports, xvi, 363.

[3] Quoted by Pleasants. Loc. cit.

[4] J. Med. Research, 1919, p. 339.

consideration. In this case a patient, age 22, died 25 days after the onset of influenza, which was complicated by pneumonia and empyema. At autopsy, among other lesions, there was found an ulcerative condition of the ileum, cæcum, and colon. The ulcerated areas contained a mycobacillus, which was not present in the chest lesions. Crowley concludes that the organism is a cladothrix, and that the chronic sepsis produced by the influenza and its complications so reduced the individual that an organism, ordinarily nonpathogenic, became invasive.

Beals, Blanton, and Eisendrath enumerate rupture of the rectus muscle as an abdominal complication.

We had no case of ruptured rectus, but had one abscess develop in the scar of an appendectomy, which had been healed for nearly three years. The abscess came on during convalescence from the pneumonia, after the patient had been free from fever for more than 2 weeks. The abscess was situated in the rectus muscle outside the peritoneum. The patient recovered after incision and drainage of the abscess.

REPAIR OF PERIPHERAL NERVE INJURIES[1]

By G. CARL HUBER, M.D., Ann Arbor, Michigan

FROM February, 1918, to March, 1919, the office of the Surgeon General detailed in succession Drs. Dean Lewis, J. F. Corbett, Byron Stookey, and T. Roberg to assist in promoting the study of peripheral nerve repair. These surgeons in succession performed the experimental operations, and I am greatly indebted to them for their hearty co-operation. The work was well done; throughout careful asepsis and great care in technique was exercised. In the several series of experiments undertaken, the respective animals were kept under observation for from a few days to nearly a year. At fixed times the animals operated upon were killed, the nerve operated upon exposed, gross observation recorded; if profitable, functional tests were made; and in all cases the nerve operated upon removed for histological study. The great bulk of the sections made were of tissues stained after the pyridin silver method, which gives especial differentiation of the neuraxes. Other fixing and staining methods were used as opportunity permitted or necessity demanded. In all approximately 70,000 sections are the outcome of this series of investigations—a wealth of material that should enable us to answer many questions. Naturally the work had to shape itself with reference to a practical, surgical side. In all 21 series of experiments were undertaken, totaling 279 operations.

In the early part of this work, Dean Lewis and I were interested in the study of the development of the amputation neuroma, especially in methods for obviating its formation. It was found early that the formation of the amputation neuroma could be prevented by the injection of absolute alcohol into the distal end of the severed nerve. In this series we list 37 experiments. The operations were made on the sciatic nerve of rabbits. After exposing the nerve and freeing it from its bed for a distance of 2 to 5 centimeters, the nerve was injected with about 0.5 cubic centimeters of absolute alcohol, often in two or three point injections, the needle directed upward, depending on the size of the nerve. The nerve was then cut 5 millimeters to 8 millimeters distal to the place of injection and often a segment of the distal sciatic removed. An escape of a small amount of absolute alcohol into the wound does not appear to be of consequence, since no material increase of connective tissue was noted as a result. It was found that this procedure obviated the formation of an amputation neuroma. In all of the experiments of this series, kept for a period of more than three

[1] Read before the Central Surgical and Clinical Neurological Societies. (For Discussion, see p. 530.)

weeks, the peripheral end of the central stump runs out to a fine point, much like that of a sharpened pencil, and maintains this form for at least 5 months. Structurally considered, there is evident no neuroma formation, no proliferation of sheath cells, no marked proliferation of connective-tissue ends. Beginning with the fourth to the fifth week after operation, a down-growth of central neuraxes into the alcohol-injected field is evident. But these neuraxes have a very regular course and do not exhibit the tangling and crisscrossing observed in a neuroma. In a second series there are listed 21 operations which served as controls. In these the sciatic of rabbits was cut and resected, but no absolute alcohol was injected. These experiments were carefully done, aseptic and practically bloodless. In every experiment kept longer than 15 days, there was developed an amputation neuroma. It is not necessary to have present an infection in order that an amputation neuroma develop. An amputation neuroma should be regarded as an attempt on the part of the severed nerve at regeneration.

In a further series of control experiments, 12 in number, the sciatic of rabbits was exposed, injected with absolute alcohol in place, without consequent severance of the nerve, as is now and then done for the treatment of neuralgia. In each case paralysis followed. Beginning with about 4 weeks after the alcohol injection, down-growths of central neuraxes may be observed in sections. Such down-growing neuraxes grow through the injected area and there results a regeneration of the peripheral part of the nerve. In a series of 3 experiments, full strength acetone was used in place of absolute alcohol. Immediate paralysis, with ultimate return of function, was noted. However, an increase of the connective tissue of the nerve was noted more than when absolute alcohol was used. In all of our experiments absolute alcohol was used for injection. Dean Lewis has reported this evening on the favorable results obtained in the treatment of three cases of causalgia after exposure of the respective nerves and injection of 60 per cent alcohol. I cannot state whether the injection of alcohol of this strength would prevent the formation of an amputation neuroma. Experimentally considered there appear to be no deleterious results from the use of absolute alcohol.

By far the greater number of our experimental observations deal with the question of nerve transplantation. It is, of course, fully understood that when it is possible to bring together the severed ends of a nerve and make end-to-end suture, without undue tension, even when it is necessary to use proper posture, this is the operation of choice. In case the severed nerve ends cannot be brought together, the question of using a nerve transplant should be considered, that is, using a segment of another nerve of requisite length to bridge the gap. Following surgical usage, a nerve segment taken from another nerve of the same individual is designated as auto-nerve-transplant; if from a nerve of another individual, but of the same species, a homo-nerve-transplant; if from another individual but of another species, a hetero-nerve-transplant. I am aware that surgeons are not in accord with reference to the practical value of nerve transplants; experimentally, convincing evidence of their practicability can be presented.

Our experimental observations are grouped under the following series: We have a series of 17 experiments on the sciatic nerve of dogs in which after resection to the extent of nearly 3 centimeters, the gap was bridged by using as an autotransplant, one or several segments of the cutaneous radial of the opposite side. This latter nerve has a diameter which is much smaller than that of the sciatic, thus presenting a problem not unlike that met with in practical surgery; namely, of making use of one of the less essential cutaneous nerves to bridge a gap in one of the major nerves. The disparity of the size of the transplant and resected nerve was met in 6 of these experiments by suturing four segments of the cutaneous radical between the resected sciatic ends. This we have spoken of as a cable-auto-nerve-transplant, and must regard it as an operation, judging from experimental results, deserving consideration in practical surgery. Of these 6 experiments, that of the shortest duration terminated in 11 days;

that of the longest in 382 days. In all of them the funicular structure of the transplanted nerve segments was fully maintained. The four transplanted nerve segments early became surrounded by a common connective-tissue sheath, serving as an epineural sheath. In one of the experiments, terminated 26 days after operation, down-growing neuraxes are found to have penetrated all of the several funiculi of the four transplanted nerve segments to the extent of approximately 2 centimeters, thus nearly reaching the distal wound. In the experiments of longer duration down-growing neuraxes are found to have reached the distal sciatic with ultimate recovery of function in the calf and interossei muscles, as tested functionally and noted in microscopic preparations.

In human surgery, segments taken from the cutaneous radial, the musculocutaneous and the crural nerves may be thought of as sources for auto-nerve-transplants.

A series of 6 experiments deals with homo-nerve-transplants. The sciatic nerve of rabbits was resected and a segment of suitable length taken from the sciatic of another rabbit was used to bridge the defect. This operation can, of course, be readily done in experimental surgery; its applicability to human surgery is obviously restricted when use is made of a fresh homo-nerve-transplant. I shall later refer to other series of homo-nerve-transplants, which have a more practical bearing. In the series under discussion, 4 of the animals were under observation for periods varying from 17 to 83 days. In each of these experiments down-growing neuraxes had either penetrated the central end of the transplant or extended through it and reached the distal sciatic, justifying the use of a homo-neuro-transplant.

We have a series of 39 experiments dealing with hetero-nerve-transplants. In the majority of these, one segment or two segments of the sciatic of a guinea pig was used to bridge a defect in the sciatic of a rabbit, caused by resection. In 3 experiments a nerve taken from a dog was used for this purpose. The duration of the several experiments varied from 3 to 358 days. The value of the use of hetero-transplants is, I believe, still under consideration in surgery with prevailing opinion against justification. This series of experiments is perhaps more of academic than practical interest, and will thus be summarized here only very briefly. At the outset it may be stated that while regeneration through a hetero-nerve-transplant may be obtained experimentally, the outcome is less certain and less satisfactory and in general requires longer time than when auto- or homo-nerve-transplants are employed. In serial sections of nerves obtained from many of the series in which new neuraxes were found in the distal nerve, it can be shown that many of the down-growing neuraxes pass outside of the nerve transplant and thus reach the distal nerve segment, the hetero-nerve-transplant thus serving only indirectly in guiding neuraxes distally. The mere study of the return of function does not adequately consider this question; a study of serial sections of the nerve involved is necessary.

It is a well-known observation that transplanted nerve segments undergo structural change after transplantation, whether auto-homo- or hetero-nerve-transplants. The process is not identical in the three types of nerve transplants, but this need not engage us for the moment. It occurred to Dean Lewis and myself that since a nerve transplant degenerates after transplantation, the process of regeneration through a nerve transplant might be facilitated and hastened by using as a transplant a segment of a nerve already in process of wallerian degeneration. A further series of experiments was thus undertaken in which degenerated auto-, homo- and hetero-nerve-transplants were used to bridge defects in resected nerves. It may be stated at the outset that our hypothesis was not substantiated. The experiments follow:

In 3 experiments a degenerated auto-nerve-transplant was used. The sciatic of a dog was cut and the wound closed. Some 20 to 30 days later, a segment of the distal degenerated sciatic was used to bridge a defect in the resected ulnar of the same dog. The several experiments ranged from 127 to 416 days. Regeneration was obtained through the transplant, but there is no indication that regeneration took place more satis-

factorily and more rapidly than it would have if an undegenerated auto-nerve-transplant had been used.

In a series of 5 experiments, degenerated homo-nerve-transplants were tested. These experiments ranged over a period varying from 17 to 328 days. In one of these experiments terminated 37 days after operation, in which a segment, 3.4 centimeters in length, from a sciatic of a dog degenerated 27 days, was transplanted to the sciatic of another dog, new neuraxes budding from the central sciatic stump were found nearly the whole length of the transplant. In experiments of longer duration peripheral regeneration was obtained. These two series may perhaps serve to show that degenerated auto-and homo-nerve-transplants may be used with assurance of success if opportunity presents.

We shall report on a series of 16 experiments dealing with degenerated hetero-nerve-transplants, the duration of the several experiments varying from 7 to 244 days. A nerve of a dog degenerated for several weeks was used to bridge a defect caused by resection of the sciatic of a rabbit. The syncytial nucleated bands which develop in a degenerated peripheral nerve may, in a measure, be regarded as representing a reversion to embryonic structure. The thought suggested itself that such tissue might be more suitable than an undegenerated nerve for a hetero-nerve-transplant. This was not found to be the case. The results of these experiments may be summarized by stating that a degenerated hetero-nerve-transplant was found to be less serviceable than a non-degenerated nerve, owing to the fact that a further degeneration ensues resulting in the formation of a tissue detritus which offers an effective block to down-growing neuraxes. Whether this block is largely mechanical or also in part of a chemical nature has not been determined.

The difficulty of obtaining on demand fresh homo-nerve-transplants in surgical practice led us to consider experimentally certain methods of storing nerves for a period of weeks before use as nerve transplants.

Dujarier and Francois[1] speak of using human nerves stored in vaseline at approximately 2° C. for periods varying from 2 to 5 weeks. Some 20 cases are reported but before sufficient time had elapsed to determine the efficacy of the method. We list a series of 8 experiments on the sciatic on rabbits in which this method was tested. Following in general the directions of the French authors, the sciatic nerve of the rabbit was removed and placed in a tube containing sterile vaseline. The tube was then corked with sterile cotton plugs and placed in a small ice chest kept at a temperature of about 3° C. At the end of approximately two weeks, the tube was taken from the ice chest and warmed sufficiently to melt the vaseline. The nerve was then removed and washed in sterile rabbits' serum, when it was ready for use as a nerve transplant. The duration of the several experiments varied from 66 to 155 days. In all, down-growths of central neuraxes to and through the transplant and distal sciatic were noted. For experiments of longer duration, more than 3 months, functional return in calf muscles was noted. From a histologic study of the nerve removed, it is clear that central neuraxes grow through a homo-nerve-transplant stored in vaseline quite as readily as through a fresh homo-nerve-transplant.

The method of Dujarier and Francois of storing nerves in vaseline is not readily carried out and certain steps appeared to us unnecessary. We, therefore, developed a method of storing nerves in liquid petrolatum. This method is simpler of application and equally effective. Sciatic nerves removed from rabbits under aseptic precautions were placed in sterile liquid petrolatum kept in long tube vials corked with sterile cotton plug. These tubes were then placed in a small ice chest, kept at a temperature of 3° C. There they remained for periods varying from 7 to 39 days. When required a tube was taken from the ice chest, the nerve removed from the liquid petrolatum, held at one end with forceps and allowed to drain until no more liquid petrolatum dripped off, sutures were then placed at the desired interval and the nerve segment cut to desired length, for the majority of cases about 3 centimeters, and then transplanted to a resected sciatic

[1] Bull. et mém. Soc. de chir. Par. 1-18 Jan.

of a rabbit. In all we list a series of 40 experiments dealing with homo-nerve-transplant stored in liquid petrolatum. This method of storage is simple and easily carried out. The small amount of liquid petrolatum adhering to the nerve does not appear to influence the course of the experiment. No infection was noted in any of the experiments; the wounds healed readily and satisfactorily. Of these experiments 20 were carried on for periods of 3 months or longer, the longest for a period of 276 days. In all of these, where functional tests could be made, return of function in the calf muscles was noted; for longer time experiments return of function in the foot interossei muscles also. In sections derived from the nerves operated upon which were removed in these cases, down-growing neuraxes were found in the distal sciatic, in the smaller muscular branches, as also motor nerve endings in the muscle. In so far as experimental evidence admits of judgment, homo-nerve-transplants stored in liquid petrolatum for a period of about 5 weeks may be regarded as serviceable material for use in bridging defects in nerves.

A further series of 19 experiments deals with homo-nerve-transplants stored in sterile 50 per cent alcohol at room temperature. Nageotte, a French scientist, has reported experimental work in which the sciatic nerves of calves, newborn or stillborn, were stored for periods in 50 per cent alcohol and then used as nerve transplants, in his experiments as hetero-nerve-transplants. This method has, I believe, been given some consideration by certain French surgeons. During Dr. Roberg's association with me, the series of experiments on homo-nerve-transplants stored in 50 per cent alcohol at room temperature was undertaken. Fresh sciatic nerves of rabbits were removed under strict asepsis, placed in sterile bottles containing 50 per cent alcohol for periods varying from 10 to 30 days, and kept at room temperature. When needed for transplantation a nerve segment was taken from the alcohol and placed for 10 to 20 minutes in warmed, sterile saline solution, sutures passed, the nerve cut to required length, approximately 3 centimeters, and then used as transplant. In 8 experiments of this series the period of observation was longer than 3 months and in each of these regeneration of the distal nerve through the transplant was attained. Functional return in calf and in foot muscles was obtained.

The supposition is permissible that, in nerves stored in sterile vaseline and liquid petrolatum at a temperatrue of 3° C., some degree of viability of certain tissue elements, sheath cells and connective-tissue cells is retained, even though there is no satisfactory evidence of the proliferation of the sheath cells of the transplanted nerve fibers nor their participation in the down-growth of central neuraxes. In the case of alcohol-stored nerves, it cannot be supposed that viability is retained by any of the tissue elements of the stored nerves. Therefore, the supposition seemed justified that hetero-nerve-transplants stored in liquid petrolatum or especially alcohol would prove more satisfactory than fresh hetero-nerve-transplants.

A series of 6 experiments were undertaken to test the value of hetero-nerve-transplants stored in liquid petrolatum. Segments were taken from nerves of dogs and stored in liquid petrolatum after the manner previously indicated, which after 10 to 20 days were used as transplants to bridge defects in resected sciatic nerves of rabbits. The several experiments range in duration for periods varying from 5 days to 138 days. The results attained may be summarized by stating that in no instance was successful regeneration through a hetero-nerve-transplant stored in liquid petrolatum attained.

A series of 3 experiments is listed in which a nerve segment removed from a dog was stored in 50 per cent alcohol for a period of 10 days and then used to bridge a defect in the sciatic of a rabbit caused by resection. The several animals were under observation for periods varying from 64 to 154 days. Some down-growth of central neuraxes through the nerve transplant was obtained, though not of sufficient extent to give functional return in calf muscles. Judging from the limited number of experiments it would seem to appear that hetero-nerve-transplants stored in 50 per cent alcohol do not offer nearly as good a

medium for the down-growth of central neuraxes as does a homo-nerve-transplant stored in 50 per cent alcohol.

In another series of experiments, the wrapping of a transplant and suture line with a membranous sheath, perhaps with a view of presenting encroachment of surrounding connective tissue or retaining down-growing neuraxes within a limited field, was studied. English and French surgeons have, to some extent, made use of membranous sheaths in operations of peripheral nerve repair. So far as I am aware, their value has not been studied experimentally. It was fully recognized that certain conditions realized in peripheral nerve repair, such as dense scar tissue, could not be reproduced in experimental work carried out in normal tissues. However, it was hoped that some facts of practical value might be ascertained. The experiments were all performed on the sciatic of dogs, resected and bridged by means of auto-nerve-transplants taken from the ulnar nerve of the same dog. After the nerve transplantation was completed, the field of the transplant and the central and distal suture lines were wrapped with a sheath, which sheath differed in the several series of experiments.

This series includes 14 experiments in which the auto-nerve-transplant and the suture lines were wrapped with Cargile membrane in one or several layers. In 8 of these experiments the Cargile membrane as found in the market was used. It was noted that Cargile membrane thus used is relatively quickly absorbed, so that after about 10 days very little trace could be found of it in the tissues. Cargile membrane used in this form can have little use, owing to its rapid absorption. The difficulty of obtaining Cargile membrane at the time these experiments were under way, led me to place into 70 per cent alcohol portions of a membrane not used in any one experiment with a view of re-sterilizing the same. After a time these pieces of membrane were placed in absolute alcohol, usually for about 24 hours, and before use in an operation taken from the absolute alcohol, spread out on a dry, sterile towel and allowed to dry. Cargile membrane thus treated we speak of as "alcoholized Cargile membrane." In 6 of the experiments of this series alcoholized Cargile membrane was used to ensheath the autotransplant and the suture lines. Much to our surprise, alcoholized Cargile membrane is not absorbed within a period of 5 to 6 months. Such a membrane does not appear to incite connective-tissue formation. It remains closely adherent to the transplant and the resected nerve ends and does retain within the limits of the membrane the down-growing neuraxes. It does not appear to influence, either for or against, the down-growth of central neuraxes through the transplant, but facilitates the down-growth of such neuraxes as are found in the connective tissue surrounding the transplant. It is considered that a sheath of alcoholized Cargile membrane may serve a useful purpose in peripheral nerve surgery.

In a series of 14 experiments an autofascial sheath was made. In this series after making an auto-nerve-transplant on the sciatic of a dog, the fascia lata of the same side as the nerve operation was exposed and an oblong strip about 2 centimeters wide and 5 to 6 centimeters long was removed. This fascial membrane, with its smooth side toward the nerve was then wrapped about the transplant and the suture lines, retained in place and in the form of a tube by means of central and distal stay sutures and several intervening half mattress sutures. These experiments varied in duration from 14 to 326 days. It is of interest to note that even in the longer time experiments, extending for a period of nearly a year, the autofascial sheath remained clearly defined and without material absorption. There is incited an increase of connective-tissue growth without and within the sheaths, which argues against the use of these sheaths in practical surgery. The nutrition of the transplant within the sheath does not appear to be influenced by the presence of the sheaths, since regeneration through the transplant was obtained in all experiments observed for a sufficient length of time to admit of it.

In a further series of 6 experiments the auto-nerve-transplant was wrapped with a formalized arterial sheath. These sheaths

were prepared by stretching the carotid arteries of large dogs over glass rods of suitable size, fixing the same in 5 per cent formalin for 48 hours; washing in flowing water, 24 hours; boiling 20 minutes and storing in 70 per cent alcohol. When required for use, an artery thus treated was slipped from the glass rod, cut to required length, placed for 30 minutes in warmed, sterile saline solution, and then split longitudinally along one side. This sheath was then slipped over the transplant and suture lines, held in place by central and distal stay sutures and several intervening half mattress sutures, thus forming an arterial tubular sheath surrounding transplant and the suture lines. These experiments were under observation for periods varying from 6 to 241 days. It is of interest to note that an arterial sheath, treated as here indicated will remain in place, unabsorbed and without inciting much connective-tissue formation for a period of at least 6 months. The new neuraxes that grow distalward, outside of the transplanted nerve segment are retained within the arterial sheaths. This type of sheath presents no advantages over an alcoholized Cargile membrane sheath and is not so easily prepared and applied. It incites less connective-tissue formation than does an autofascial sheath.

Our list of experiments contains only 2 experiments in which an auto-nerve-transplant was wrapped in a fat sheath. In these two experiments after completing the operation of auto-nerve-transplant, a segment of ulnar to sciatic, the transplant and suture lines were wrapped by means of a fat layer taken from the subcutaneous fat of the same animal, and held in place by stay sutures. One of the experiments was terminated by death of the animal 4 days after the operation. The other was continued 238 days. In the latter experiment, while regeneration of the distal nerve was obtained through the transplant, the fat sheath was entirely replaced by dense connective tissue, so that in the field of operation the nerve trunk was surrounded and bound down by extensive connective-tissue formation, more so than observed in any other type of operation. This argues strongly against fat sheaths in peripheral nerve repair.

In a further series of 13 experiments we made use of an arterial tubular suture to bridge a defect in a resected nerve. Arterial tubular sutures were experimentally tested by Foramitti. This method of nerve repair was used to some extent by Hashimoto in the Russo-Japanese War; by other surgeons in the first and second Balkan Wars. In our experiments we followed Foramitti in the preparation of the arterial tubes, however, using the carotid artery of dogs instead of the carotid arteries of calves as recommended by Foramitti. The arterial tubes were prepared by stretching the carotid arteries of large dogs over glass rods of suitable size fixing them in 5 per cent formalin for 48 hours; washing for 24 hours in flowing water; boiling for 20 minutes; then storing in 70 per cent alcohol, in which they may be kept for days. When required for use an artery thus treated was taken from the alcohol, slipped from the glass rod, cut to required length and then placed in warmed, sterile saline solution for about 30 minutes. The manner of use for bridging is as follows:

A suture threaded at both ends with a fine needle is passed through the central and distal end of a cut nerve several millimeters from the cut ends. Centrally and distally the needles are then passed through opposing side of the arterial tube near the two ends of the tube, and the resected nerve ends drawn into the lumen of the artery and held in place by tying the suture over the artery. In the several experiments of this series, the time of observation varied 6 days to 298 days. It is interesting to note that arterial tubes prepared as above indicated, when placed in position in tubular sutures are not absorbed for a period of at least 5 months. Their presence in tissue does not especially incite connective-tissue formation. There is practically no penetration of connective tissue through the wall of the tube and a negligible in-wandering of leucocytes through the arterial wall. A small amount of connective tissue is found within the lumen of the arterial tube in long time experiments, derived, I believe, from the resected nerve ends. In 4 of the experiments kept longer than 4 months, down-growing neuraxes derived from the central stump

had passed through the lumen of the artery, in one experiment a distance of approximately 4 centimeters, and reached the distal nerve, in which beginning regeneration was noted. While regeneration through an arterial tube is a possibility, this method does not commend itself for surgical practice since it is less certain of favorable results than when auto- or homo-nerve-transplants are used.

In certain of our experiments in which the ulnar nerve was resected to the extent of 4 to 5 centimeters for the purpose of obtaining a nerve segment to be used as an auto-nerve-transplant in another operation, the resected ulnar nerve ends were brought together as closely as possible by means of a tension silk suture. In certain of these experiments the suture line was wrapped with Cargile membrane; others with formalized arterial sheath. The leg operated upon was not immobilized. Of the 13 experiments of this nature in all but 2 the tension suture gave way, admitting a separation of the resected nerve ends. In the two experiments in which the suture maintained, down-growth of central neuraxes to the distal segment was noted. It is recognized that this series of experiments does not warrant drawing more than limited deductions as to the value of tension sutures. Immobilization of parts did not seem practicable. They may serve to show that sutures alone are not sufficient to retain resected nerve ends in position if undue tension is used to bring the nerve ends together.

By way of final summary the following points may receive special consideration:

The results of all the experimental work on nerve transplantation indicate clearly, it seems to me, that the most favorable results are to be obtained after the use of auto-nerve-transplant and for practical surgery a cable-auto-nerve-transplant, using several segments of a cutaneous sensory nerve to bridge a defect in a larger motor-sensory nerve. The question of the type of nerve is not material; the question of the funicular arrangement is of secondary importance; whether the central or the distal end of transplant is placed centrally is not necessary of consideration; accurate end-to-end suture, careful technique, and dry field, are essential, I believe.

As concerns fresh homo-nerve-transplants. I believe I am justified in stating that they serve the purpose of bridging nerve defects quite as well as auto-nerve-transplants, if available, which would very probably not often be the case in practical surgery. I believe that experimental observations justify the use of stored homo-nerve-transplants; nerves stored either in sterile vaseline, sterile liquid petrolatum, or even 50 per cent alcohol. If nerves can be stored under proper precautions for 40 days in liquid petrolatum and serve as transplants, I see no reason why they may not be stored 80 days or even longer. The favorable results obtained after using nerves stored in 50 per cent alcohol indicate that value of the nerve transplant is not dependent on the presence of living sheath cells and there is no question of the nerve fibers of a nerve segment stored in 50 per cent alcohol undergoing wallerian degeneration as does the peripheral part of a nerve after section. The neurilemma sheaths maintain and through these the central neuraxes reach the distal nerve segment.

As concerns the general question of the use of sheaths about nerve suture lines or transplants, it may be stated that as a general rule sheathing is not necessary, and while perhaps not harmful, they serve no specific purpose. Considered in the light of our experimental work the use of an alcoholized Cargile membrane sheath may be justified in certain cases. There is very little connective-tissue formation consequent to their use; they remain in place unabsorbed for nearly 5 months after being placed in the wound. I should like to see this method of sheathing tried in cases in which much fibrous tissue is present in the field of nerve repair, especially in cases in which it is not possible to do muscle neurolysis as has been so successfully done by Dean Lewis in certain cases.

There is one more point I should like to refer to in connection with our experimental work, namely, the importance of having dry, clean wounds, before the wound is closed. There would appear to be a correlation between a field not quite dry and an increase of connective tissue about the nerve operated upon.

THE CLINICAL SIGNS OF NERVE INJURY AND REGENERATION[1]

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CLINICAL signs of nerve regeneration arethe manifestations of the spontaneous recovery of an injured nerve or the recovery consequent to the suture of the ends of a divided nerve or that following some operative procedure performed upon an injured nerve which has shown signs of physiological interruption. To a large degree, signs of regeneration consist in the evidence of return of function. It is necessary, therefore, to define the signs of loss of function.

Many attempts have been made to discover a sign or groups of signs which would justify a rapid differential diagnosis between a case having a complete anatomical section of a nerve and one in which complete loss of function is not the result of division of the nerve. Similarly, attempts have been made to differentiate between those cases which have had complete loss of function and which spontaneously recover and those cases which do not recover spontaneously but require surgical interference.

At one time it was thought possible to distinguish several definite syndromes. Prominent among these were the groups adopted by Mme. Dejerine and J. Mouzon.[2] They defined the syndromes of interruption, of compression, of irritation, of dissociation, and of recovery, each having a distinctive group of symptoms. Unfortunately, it was proven by others by subsequent observations that this classification was artificial and unreliable for the purpose of certain diagnoses.

To my knowledge there is no way by which the complete loss of function due to anatomical interruption can be differentiated from the complete loss of function due to physiological interruption produced by compression, etc. From a single examination, at a given time, we can only determine whether the lesion is complete or incomplete. If the lesion is complete we cannot tell whether it is due to anatomical interruption or not, nor can we predicate whether it will spontaneously recover or require surgical treatment. Of course, if the lesion is incomplete, anatomical division cannot be present except in the form of a lateral notch.

In a case of complete physiological interruption, only when a subsequent examination shows some return of function may we say that the lesion is incomplete and an anatomical interruption absent. No other sign or group of signs suffice. In general, the course of the clinical picture is much more important than any group of signs for the purpose of determining the severity of a lesion.

The various clinical signs resulting from a complete interruption of a nerve have been given a different value and significance by different investigators. Each one has proposed a certain grouping of symptoms in the order of their supposed value and many have added certain signs of their own. Common to most may be found, (1) complete paralysis of all muscles supplied by the nerve below the lesion; (2) complete reaction of degeneration; (3) rapid and extensive atrophy of the paralyzed muscles; (4) absence of pain on pressure applied to the nerve trunk below the lesion; (5) loss of objective sensibility in the supply of the affected nerve. Many include absence of tonicity with characteristic attitudes of the limbs in repose, as wrist-drop, foot-drop, etc., absence of any pain on pressure of the muscles supplied by the injured nerve, exaggerated excitability of the muscles to mechanical stimuli, abolition of corresponding reflexes, absence of any zone of hyperæsthesia or paræsthesia in the region supplied by the injured nerve, vasomotor and trophic disturbances.

Much of the difficulty in determining the presence or absence of severe lesions may be attributed to the lack of standardized methods of examination, careless and verbose descriptions, and lack of knowledge of the physiology of the peripheral nervous system.

[2] Presse méd., 1915, May 10, July 8, August 30.

[1] Read before a joint meeting of the Chicago Surgical and Neurological Societies, January 2, 1920. (For discussion see p. 530.)

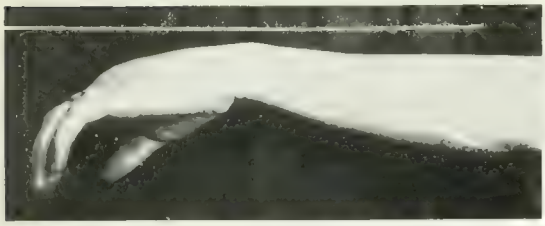


Fig. 1. Wrist drop in musculospiral palsy.

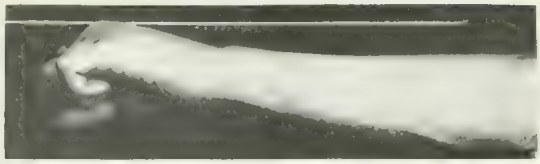


Fig. 2. Extension of wrist by supplementary movement of flexion of fingers.

So much is this true, that in describing the sensory changes present in severe lesions of peripheral nerves, it was necessary for one distinguished author to refer to them as "considerable disturbances of objective sensibility." If a complete interruption of a sensory or mixed nerve be present, complete loss of sensory function would follow, and if we knew how to determine it and of what it consisted, recourse to such descriptions would be unnecessary.

Because of these difficulties I shall define the extent to which I believe the loss of such functions as I consider most important, may be employed in determining the severity of a peripheral nerve lesion.

Complete loss of all the functions of a nerve indicates a severe lesion and is interpreted as a complete physiological interruption of that nerve.

Total paralysis of all the muscles supplied by a nerve distal to a lesion cannot alone be used as an indication of the severity of that lesion. Particularly is this true of the musculospiral nerve, slight injuries of which produce total paralysis.

Motion of segments about a joint does not indicate the integrity of the function of the nerve supplying the muscles ordinarily supposed to move such segments. The preservation of the function of muscles is largely determined through the examination of the movements of segments and not of the muscles themselves. The frequency with which more than one muscle may produce a similar movement of the segments about a joint makes this type of examination unreliable unless certain care be exercised.

The preservation of certain movements, the loss of which is supposed to follow particular nerve lesions, has been observed for many years. These movements may be caused by a number of factors; among which may be included, the anastomotic supply of muscles from adjacent nerves, movements produced by muscles other than primary movers in a particular action, movements occurring as a result of mechanical factors producing a change of direction of leverage by shortening and lengthening the tendons and muscles passing over several joints, and slight movements resulting from the recoil of elastic tissues following a movement in a direction opposite to the one desired. It is misinterpretation of such supplementary movements which lead to incorrect opinions that complete lesions are incomplete ones (Figs. 1, 2, 3, 4, and 5).

Our knowledge of the sensory changes following peripheral nerve lesions is in a chaotic state; partly because of the lack of standardized methods of examination but principally because of the lack of knowledge of the extent of the supplementary function of sensation of adjacent nerves.

It is well known that following a division of a mixed nerve, there is seen a certain area in which all sensation is lost surrounded by an area in which stimuli to pin prick and extreme degrees of temperature are felt. This area is known as the intermediate zone. The apparent sensory dissociation and the subsequent behavior of the two zones led to the

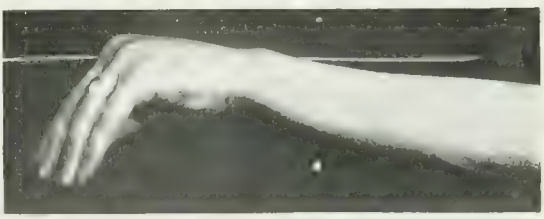


Fig. 3. Extension of wrist by supplementary movement of contraction of pronator radii teres.

Fig. 4. Opposition of the thumb by the adductor pollicis and flexor brevis pollicis in median nerve palsy.

Fig. 5. Adduction of the thumb by the extensor longus pollicis in ulnar palsy.

formulation by Head[1] and his co-workers of their theory that the sensory mechanism in the peripheral nerves consists of three systems: deep sensibility, protopathic sensibility, and epicritic sensibility. The sensibility to painful stimuli by pin prick which was present soon after an injury in that portion of the skin contained within the borders of the anatomic sensory distribution of a nerve was attributed by them to the function of overlapping adjacent nerves.

It is obvious that if any of the skin within the borders of the accepted anatomic sensory distribution of a nerve becomes sensitive to pin prick because of nerve overlap, it is necessary to determine to what extent this function can possibly develop, which can readily be done by determining the residual sensibility of a nerve. By this is meant that area of skin in which sensibility is preserved after all the nerves adjacent to the one being studied have been severed. For example, if we wish to determine the residual sensibility to pin prick of the radial nerve on the anterior surface of the hand, it is necessary to sever the remaining nerves which supply this area, namely, the musculocutaneous, ulnar, and median. What sensibility remains can be attributed only to the function of the radial nerve (Fig. 6).

From a large collection of similarly combined lesions found among over one thousand cases, I have been able to reconstruct the area of residual sensibility of a number of peripheral nerves. That portion of the residual sensibility of a nerve which extends into the recognized sensory distribution of an adjacent nerve is the overlap of the former on to the latter. Therefore, even if pain to pin prick be felt in this overlap area following an injury to such an adjacent nerve, it does not indicate a partial or recovering lesion. Only when sensation is present in the isolated supply of a nerve can the lesion be considered as a partial one. The area of the isolated supply to pin prick of various nerves is the area in which no overlapping occurs.

Corresponding to the area of the isolated supply of a nerve to pin prick is found analgesia to pinching, in my opinion an excellent indication of a severe nerve lesion.

Regarding the electrical changes demonstrated by the methods personally employed, namely, faradic, and galvanic stimulation, it may be said that complete reaction of degeneration is always present in a severe lesion but does not indicate an irreparable one. Of all the changes to electrical stimulation, the slowness of the muscular contraction is the only constant phenomenon which can be satisfactorily employed in determining the reaction of degeneration. Polar changes are inconstant and of course it may be expected the response to faradism would be absent frequently, even in partial lesions. Especially is this true of cases requiring more than 4 months for recovery. Although electrical examinations afforded no means whereby a differentiation between anatomical and physiological interruption could be made in the cases observed within a year following injury, it must be remembered that frequently after this period and always after a hundred

[1]Brain, 1905, xxviii, p. 111.

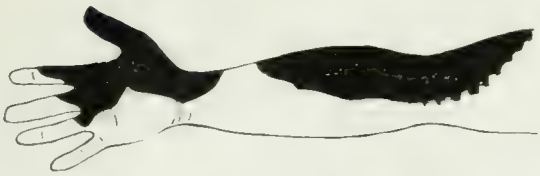


Fig. 6. Residual sensibility to pin prick of the radial nerve.

weeks, irreparable lesions show complete loss of response to any form of electrical stimulation.

The longitudinal reaction did not prove to be of any particular diagnostic or prognostic value. Of some interest was the fact that masses consisting of muscles supplied by nerves, severely and often irreparably injured, showed great increase of resistance to the continuous current. The constancy of this phenomenon unfortunately could not be controlled and its real significance therefore was not determined.

Rapid and extensive atrophy of the paralyzed muscles may be interpreted as meaning a severe lesion with a number of reservations. Ulnar nerve lesions as a rule show extensive atrophy whether severe or not. Atrophy is of service in denoting the severity of a lesion only when seen soon after injury. The amount of atrophy observed some months after injury is not commensurate with the severity of the lesion.

Measuring the amount of atrophy in the upper extremities distal to the elbow and in the lower distal to the knee, by water displacement, the following facts were found. As compared to the unaffected extremity the affected one showed in an irreparable ulnar nerve lesion, an atrophy of 4.5 per cent of the total mass, in recovering lesions 4.2 per cent; in radial nerve lesions there was an atrophy of 4.3 per cent in recovering lesions and 5 per cent in irreparable ones. In lesions of the median nerve, those recovering showed 11.2 per cent and irrecoverable ones 15 per cent atrophy; in sciatic nerve lesions recovering lesions showed 9.7 per cent and those irrecoverable 10 per cent; the external popliteal showed in the recovering lesions 6 per cent and in the irrecoverable ones 7.2 per cent atrophy.

Fig. 7. *I*. Usual area in which sensibility to pin prick is preserved in combined lesions of ulnar and median nerves, or, in this instance, ulnar, median, and musculocutaneous.

II. Analgesia in the usual algesic area when the radial nerve is divided in addition to the ulnar and median.

IIIA. Preservation of sensibility to pin prick in a combined ulnar and median lesion. *B*. Resection and suture of these nerves did not produce analgesia of the algesic area.

IVA. Analgesia in a median nerve lesion, showing preservation of sensibility to pin prick over a large portion of the radial part of the palm. *B*. Complete analgesia of the radial part of the palm produced when in this case the superficial radial nerve was severed to be used as a cable transplant.

Although the percentage of loss of muscle mass was slightly greater in the severe, irrecoverable lesions, the difference was not

Fig. 8. Sign of complete recovery of musculospiral paralysis.

sufficient to be of diagnostic value. In addition to this, some irrecoverable sciatic nerve lesions showed but 1 per cent loss when a recovering showed a 17 per cent loss. In a recovering external popliteal nerve lesion we found 16 per cent and in an irrecoverable one only 1 per cent atrophy, etc.

In general it may be said that when observed some months after injury, absence of demonstrable atrophy is not an indication of a reparable lesion. It has impressed me that movement of the extremity, passive or active is often responsible for an apparent lack of atrophy. How much any replacement of muscle by other tissue is responsible can only be conjectured.

Absence of pain, when the trunk of the nerve is subjected to pressure below the seat of the lesion, was demonstrable in many severe lesions, but quite a number of recoverable lesions showed this analgesia as well. On the other hand, not a few irrecoverable lesions showed the preservation of pain to such pressure. Only the ulnar, musculospiral, and external popliteal nerves are suitable for isolated pressure upon their trunks, and this only in those cases in which the injury is proximal to their superficial positions. The danger of producing pain by pressure upon adjacent structures is too great to make this a universally diagnostic phenomenon of certain value.

In agreement with Meige and Pitres[1] absence of any pain or pressure of the muscles which are paralyzed was found a very unreliable sign. In fact it was found that in a large number of cases, tenderness to pressure was more marked on the injured side and could probably be attributed in some cases, to the injury of other tissues; in others, to supplementary supply of sensation of the paralyzed muscle by adjacent nerves.

When tone was measured by a tonometer, it was found that only for a short time after an injury of a peripheral nerve, was the loss of tone any indication of the severity of the lesion. Even in such an instance the loss of the tone represented only a reflection of the general loss of function. The difference in millimeters of mercury was expressed in the ratio of from 160 to 180 in normal muscle to 40 to 60 in the paralyzed ones. In a very few weeks, infiltration, fibrosis, and other changes in the muscles and tendons vitiated what significance loss of tone might have.

Too little is known of the nature of trophic disturbances to enable us to employ them profitably in interpreting the severity of the lesion. Where protopathic sensibility was lost trophic ulcers were likely to occur. When an extremity was immobilized, growth of nails ceased. When an extremity was protected by a dressing hypertrichosis was at times observed. Generalized atrophy of the bones indicated only disuse. In other words the trophic disturbances can be employed as

[1] Rev. neurol., Par., 1926, April–May.

an indication of the severity of the nerve lesion only when judged in the light of the presence of other conditions.

As to the absence of hyperæsthesia in the regions supplied by an injured nerve as an indication of complete interruption of that nerve, it can be stated definitely that as a matter of fact hyperæsthesia is not uncommon in just such cases, when sensation to pin prick has returned as the result of nerve overlap.

The signs of regeneration of a nerve are the manifestations of recovery of function. Among these are return of sensation, both subjective and objective, disappearance of reaction of degeneration, increase of tone, disappearance of atrophy and return of motion.

These manifestations differ in appearance and rate of return as to the pathology of the nerve and as to whether recovery is spontaneous or is consequent to surgical intervention. They are dependent upon the condition of the neuraxones. If descending degeneration has been slight or absent and the nerve recovers spontaneously and rapidly one type of course is followed; if resection and suture has been performed another type is observed. If little or no degeneration has followed, but a complete physiological interruption has existed for a long time, because perhaps of a constricting band, surgical relief of this morbidity is followed by a regeneration similar in character to that observed in lesions rapidly recovering spontaneously. If descending generation is severe or complete and conditions are such that the lesion recovers with no surgical interference, the course of recovery will be very similar to that observed following suture.

Rapidly and spontaneously recovering lesions showed two characteristics: First, in agreement with others (Sherren), I have found that such lesions do not show the dissociation of sensation previously referred to. Here little or no sensibility to pin prick returns before tactile sensation. Both forms of sensation are absent and return together. This in my opinion is due to the fact that the function of overlapping nerves is inaugurated only in the presence of a complete interruption whether it be physiological or anatomical.

Fig. 9. Pitres' test of recovered ulnar, at left; failure of test in ulnar palsy, at right.

From 200 peripheral nerve injuries which were incomplete and recovered soon after injury, only three were found where sensibility to pin prick was present and tactile sensibility absent. The return of sensibility to both pin prick and touch followed no definite rule as to its location but was in every instance patchy in character. Second, the return of function did not adhere to any definite rate of progression either as to sensation or motion and often all the muscles innervated by a nerve regained their function suddenly irrespective of their distance from the lesion.

Many cases of complete physiological interruption of a nerve showed their first sign of regeneration at such a time as one would expect it to occur were the nerve divided at the time of injury and sutured. From this time onward the regeneration progressed exactly as would a sutured nerve. It is reasonable to assume that in this type of severe lesion complete descending degeneration has occurred and conditions permitted the regeneration of the axones. Evidence of regeneration first appeared in from the eighth to ninth month, and it was noticeable that a considerable number of men wounded at about the same time, all began to improve together.

In my opinion this is additional evidence that very great conservatism should be exercised in making a decision for resection and suture in severe lesions of peripheral nerves not recovering within even 7 to 8 months.

The order in which the signs of regeneration appear have been given by Mme. Ath. Benisty[1] as follows: (1) Sensory regeneration, consisting of pain when the skin is pinched,

[1] The Treatment and Repair of Nerve Lesions. Military Medical Manuals, 1918.

Fig. 10. Inability completely to close the fist in median palsy.

pain when the nerve is pressed below the lesion, formication on pressure of the nerve and spontaneous aching in certain muscles; (2) arrest of atrophy and return of tonicity; (3) in some cases return of faradic contractility; (4) disappearance of objective sensory disturbances; and (5) voluntary movements.

As critical an examination of the clinical signs of nerve regeneration is necessary as was seen to be the case with the signs of complete physiological interruption of a nerve. In my experience return of pain upon pinching of the skin was many times the first sign of nerve regeneration, but very frequently was not. Only that return of pain to pinching which is found in such areas of skin as are outside the influence of nerve overlap, can be used as an indication of the recovery of a nerve. Frequently spontaneous aching and more frequently a sensation of a "different feeling" in an extremity preceded other signs of nerve regeneration. Pain upon pressure of the nerve trunk distal to the lesion was found unreliable.

Tinel's sign, or peripheral formication upon pressure or light percussion of the nerve trunk distal to the lesion, was found to be practically valueless. Where a nerve is superficial and pressure may be exerted upon it and it alone this sign might have some value. Unfortunately only few of the peripheral nerves have a superficial course and this only for a short distance. Elsewhere other structures may be included in the pressure. Where the sign is elicited by light percussion, the concentric waves of motion transmitted from the percussed spot may stimulate the nerve at a considerable distance.

In any event, of 50 cases of recovering lesions, 7 had complete absence of Tinel's sign and 8 had formication for only a short distance from the site of injury. Of 50 irreparable lesions, a complete Tinel's sign was obtained in more than 50 per cent of cases and only in 7 cases was it completely absent. If my technique be faulty, then I can only say that a method the success of which is dependent upon uncertain physical conditions which are poorly controlled, a method which requires a refinement of technique obtained only by a favored few is productive of an unreliable clinical sign in the hands of the standard observer.

Arrest of atrophy and return of tonicity were not profitably employed in those cases recovering some months after injury for reasons already stated.

The electrical phenomena of regeneration of nerves were observed only in those cases recovering more than 5 months after injury. They were not sufficiently critically studied to permit us to use the results obtained in judging the reliability of current views. It may be well to state, however, that in the partial lesions which showed beginning recovery before the eighth month following injury, a response to faradism at times returned before motion. At times motion was present and faradic response absent. The cases showing beginning regeneration following resection and suture, performed not less than 6 months following injury, never showed any return of response to faradism before the return of motion. The same is true of the cases showing beginning spontaneous regeneration only 8 months or more after the injury.

It has been noted by most observers that sensation to pin prick and extreme degrees of temperature (protopathic sensibility) returns long before tactile sensibility and before motor function. This return of sensation to pin prick in the anatomic sensory distribution of a nerve, which occurs some time, i.e. more than 43 days, following injury, was attributed by Head and his co-workers to be due to the early regeneration of protopathic fibers.

Fig. 11. Closure of fist in recovered median palsy.

Fig. 12. Closure of fist in recovered median palsy.

The length of the nerve to be regenerated made no difference as to the time of the first appearance of sensibility to pain.

Such a lawless regeneration appears to me to be short of the miraculous. I maintain that the return of sensibility to pin prick, which occurs before the return of sensibility to touch, is present only in regions which occupy the areas of nerve overlap, and that this return of sensibility to pin prick cannot be interpreted as a sign of nerve regeneration. I am supported in this view by the facts that I have never found a return of sensibility to pain, when sensibility to touch has not returned, except in an area of overlap (Fig. 7, *I*); that when a nerve is divided and at the same time one or more adjacent nerves are divided, sensation to pin prick does not return in the area of overlap of these nerves even many months following injury (Fig. 7, *II*); that when a nerve adjacent to one that is severed and which supplies an area of overlap to that nerve is sectioned, the pre-existing sensibility to pin prick in the overlap area is lost (Fig. 7, *IVA*, *IVB*); that when sensibility to pin prick is present within the anatomic sensory distribution of a severed nerve, resection and suture has no effect upon the general outline of this area of sensibility (Fig. 7, *IIIA*, *IIIB*).

Only when that portion of the area representing the anatomic sensory supply of an injured nerve, removed from the influence of overlap, in other words its isolated supply, becomes sensitive, can we say that regeneration is present. Under this condition at no time did protopathic sensibility return before epicritic. When sensation returned, it became evident in patches scattered over the heretofore analgesic zone and not only upon the borders of this zone. Likewise under this condition, only once in 67 cases of complete physiological interruption of a nerve recovering following surgical treatment, did sensation return before motion.

In the interpretation of the significance of return of motion relative to regeneration, proper recognition must be made of supplementary motility. So great does this influence the movement of some segments that I have never been able definitely to state that such movements as I have observed return following resection and suture of the ulnar nerve, were due unquestionably to nerve regeneration, with the exception of a distinct contraction of the flexor carpi ulnaris. These movements are likewise very confusing in median nerve lesions. Some of the movements which cannot be supplemented in the various nerve lesions are:

In musculospiral lesions, extension of the proximal phalanx of the thumb and abduction of the thumb in the plane of the palm, and extension (not alone tension) of the proximal phalanges of the fingers. In ulnar nerve lesions, flexion of the proximal phalanges of the ring and little fingers with the distal phalanges extended, and lateral movements of the extended middle finger. In median nerve lesions, flexion of the distal phalanx of the index finger and of the thumb. In combined lesions of the ulnar and median nerves, all movements of the hand except flexion at the wrist and hollowing of the hand. In external popliteal lesions, eversion of the foot.

Some signs of complete motor recovery are of value: in the musculospiral nerve, placing

the little finger on the seam of the trousers with the fingers well extended and with the palm turned to the front, is a sign suggested by Pitres[1] (Fig. 8).

In ulnar nerve lesions, he suggests that the palm be placed flat upon a table with the fingers apart, then the middle finger should be moved inward and outward and finally the table scratched with the nail of the little finger without moving the wrist (Fig. 9). In median nerve lesions Claude[2] suggests the clenching of the fist with all the fingers well flexed into the palm and with the distal phalanx of the thumb firmly pressed upon the dorsal aspect of the second phalanx of the middle finger (Figs. 10, 11, and 12).

It has been observed by Mme. Ath. Benisty[3] that in individual nerves, certain muscles recover motility in a definite order.

In a general way the cases recovering spontaneously showed this individual characteristic in our experience. In musculospiral lesions the extensors of the wrist were the first to recover, followed by the extensors of the fingers, then the abductor and extensor of the thumb. In ulnar nerve lesions the intrinsic muscles of the hand were the last to recover. In median nerve lesions, the muscles of the thenar eminence and the flexor of the index finger were the last to recover. In external popliteal lesions the extensors of the toes and in sciatic nerve lesions the tibialis posticus and the flexors and extensors of the toes were the last to recover.

Cases recovering following primary and secondary suture did not always adhere to a definite rule. Of these I observed only 39 cases and among them the following muscles showed the first return in the various lesions: In musculospiral lesions following primary sutures the extensors of the wrist, the extensor communis digitorum and abductor pollicis, followed by the extensor longus pollicis, following secondary suture, extensors of wrist, followed by the extensors of the fingers, then the thumb. In median nerve lesions following secondary suture, the pronator radii teres, the palmaris longus, and flexor carpi radialis were the first to recover. The supplementary movement in ulnar nerve lesions was so extensive that it was not profitable to attempt to determine what muscle regained its function first. In combined lesions of the ulnar and median nerves, the flexor carpi ulnaris, flexor longus pollicis, and flexor sublimus digitorum were the first muscles to functionate following secondary suture. In the external popliteal nerve the peronei, tibialis anticus, extensor longus digitorum, and extensor hallucis were the muscles to recover first, in the order named, following primary suture. Following secondary suture the tibialis anticus and extensor longus digitorum returned first. In the sciatic nerve, following primary suture, the peronei and the extensor longus digitorum were the first to recover. Following secondary suture the gastrocnemius and tibialis posticus were the first to recover.

Following primary suture the first return of motion was observed in 6 months in musculospiral lesions. The first return of motion in external popliteal cases was observed 7 months, and in sciatic nerve lesions 6½ months, following primary suture. In musculospiral lesions following secondary sutures, the first return of function occurred from 5 to 6 months after suture. In secondary sutures of the sciatic nerve the first return of function was apparent in 6½ months. In external popliteal nerves the first return of function occurred in 8 months following suture. In a combined ulnar and median nerve lesion, muscles innervated by both nerves showed return of function in a little over 6 months following secondary suture.

Of all the signs of regeneration of a nerve, I consider the disappearance of the reaction of degeneration, the return of objective sensibility in the isolated supply of a peripheral nerve, and the return of motion, as the only certain ones. The sensory and motor signs are the only constant ones. The other signs which have been mentioned are suggestive but not positive. The only objective sensory phenomenon which precedes the return of motion is pain on pinching in the isolated supply of the nerve. Sensibility to pain and touch return at the same time.

[1]Rev. Neurol, 1916, April-May, p. 486.
[2]Quoted by Benisty. Clinical Forms of Nerve Lesions.
[3]Loc. cit.

CERVICAL RIBS

With Presentation of Cases and a Bibliography

By JAMES A. HONEIJ, M.D., New Haven, Connecticut

CERVICAL ribs present two interesting groups of cases: those that have all the symptoms associated with this condition and yet have no cervical ribs and those that give no symptoms and on examination prove to have cervical ribs.

After reviewing the enormous literature on the subject and especially after reading Keen's and also Streissler's very excellent articles, little remains to be said. The subject, however, is still interesting, and because of a rather large and varied group of cases with and without cervical ribs, an added report did not seem wholly unwarranted.

In reviewing the literature, one is struck by much contradictory evidence; statements are made regarding the common occurrence and also the variety of cervical ribs, of the lack of and the numerous symptoms, the difficulty and also the ease of diagnosis, of the worth and uselessness of radiographic diagnosis. Some authors believe cervical ribs occur more commonly bilaterally. Very few make the distinction between true cervical ribs and normal transverse processes and all the intermediary conditions between these. There has obviously been a lack of study of individual cases and a lack of understanding of the development of supernumerary or rudimentary ribs.

In studying a group of negative cervical rib cases with positive symptoms, I was rewarded by finding large, irregular transverse processes of the seventh cervical vertebra with a very narrow space between it and the first thoracic rib, which could very naturally cause all the symptoms of which the patients complain. The reverse is equally true. To prove this statement, cases of true cervical ribs were found where the costal space was so wide that pressure on nerves and blood vessels was improbable and consequently could not give rise to symptoms. Cases with curvature of the spine with relatively insignificant pressure, transverse processes or rudimentary ribs can, on the other hand, give rise to very severe symptoms. There is apparently a lack of appreciation of the many factors which produce symptoms and a limited point of view in considering true cervical ribs.

In a review of the literature to determine the most common symptoms for comparison with the cases reported here, it was interesting but impossible to tabulate the enormous variety and combination of symptoms. They divide themselves naturally into circulatory and nerve conditions and into muscular and other secondary symptoms. Keen gives an excellent division of symptoms as follows:

1. Local symptoms: tumor, pain on pressure, bruit, etc.

2. Nervous symptoms more frequent than vascular.

3. Vascular symptoms: pulsations, ischæmia, gangrene, œdema, thrombosis, aneurism.

4. Muscular symptoms: wasting, loss of power, easily tired, dysphagia. Scoliosis.

Cases have been reported with symptoms resembling Pott's disease, Raynaud's disease, hyperthyroidism, aneurism, and others as a cause of Klumpke-Déjerine's paralysis; a larger number of cases have been reported with various forms of neuritis than with vascular disturbances; many cases with trophic and vasomotor affections; others with muscular atrophy and sensory disturbances and again others with only atrophy of the hand muscles. In a few cases, there was definite dilatation of the subclavian vessels and one case was reported giving rise to a spasm of the diaphragm. Gangrene as an end-result of various preceding disturbances is not uncommon. In two cases, cervical rib had an etiology of hereditary syphilis. Since the symptoms in cervical ribs may vary from the slightest nerve, vascular, or muscular symptoms to the

Fig. 1.

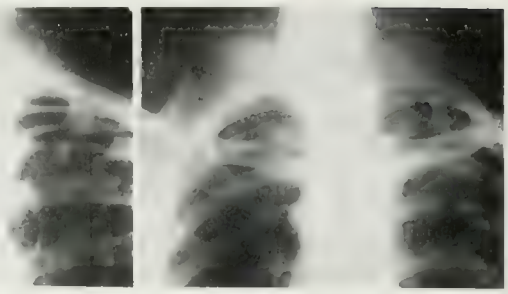


Fig. 1a.

Fig. 2.

Fig. 1. Case XX. Female. History not known. Normal symmetrical thorax. Roentgenograph shows a completely developed seventh cervical rib on the right fused with first dorsal rib. On the left the transverse process of the seventh cervical rib shows a small rudimentary tubercle.

Fig. 1a. Case 3446. B., male, age 32. October, 1919. No symptoms due to cervical ribs. Question of pulmonary tuberculosis. Roentgenograph shows typical bilateral seventh cervical ribs, most prominent on the left.

Fig. 2. Case 3025. C., male, age 26. Private M. C. No symptoms, no history. X-ray examination shows some diffuse peribronchial thickening. Thorax is asymmetrical. Complete cervical rib on right, one-half the size of the first thoracic rib. There is a small rudimentary rib on the left.

most severe changes, and since the diagnosis of cervical ribs from symptoms alone may be confused with various diseases, it is obvious, therefore, that there are no definite symptoms or group of symptoms positive of cervical ribs. And, as has already been pointed out, symptoms resembling those that are found in cervical ribs, frequently occur without other evidence of cervical ribs. It is interesting, however, to consider what conditions may cause symptoms which may be mistaken for cervical rib.

a. Results from disease or traumatism: pulmonary apical tuberculosis. Callus formation from fracture of the first thoracic rib, clavicle.

b. Tumor growths: glands, aneurism, enlarged thyroid.

c. Scoliosis, unilateral compression.

d. Abnormalities: First thoracic rib. Clavicle.

e. Inflammatory conditions: transitory torticolis; of shoulder-joint; neuritis (occupational).

f. Exostosis of transverse processes. Scalene attachment. Localized myositis ossificans.

Scoliosis is frequently mentioned in connection with this condition (Schoenebeck), but the effort to determine whether an increasing scoliosis was the cause of symptoms where there were prominent transverse processes or even cervical ribs, or whether cervical ribs gave rise to a scoliosis, met without success.

Another interesting and not uncommon point is that after operation severe scar-tissue formation has often resulted, which has given rise to all the previous symptoms of cervical ribs and, in some cases, these symptoms were more severe after operation than before. There is still another interesting factor in the production of symptoms. The frequency of accidents as a cause is abundantly reported which is also apparent in the cases reported here. Muscular effort, bony compression, inflammation, and in elderly individuals, change in posture with forward or lateral bending of the vertebral column associated with tissue changes, may all give rise to symptoms with either cervical ribs or enlarged transverse processes present. These last factors are far more commonly associated with cervical ribs than the spontaneous occurrence of symptoms. This opinion is based on the review of the literature between the years 1894 and 1918, which gives approximately 200 cases in 152 articles as well as on the cases here reported. The number of cases reported during this period is far greater than all those reported up to 1894. Pilling collected cases totaling 139. In most of these cases the cervical ribs were found on postmortem examination.

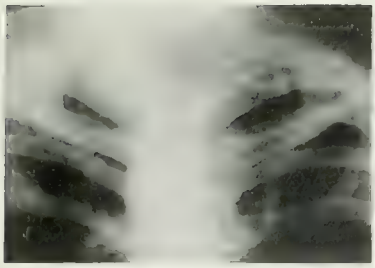


Fig. 3.

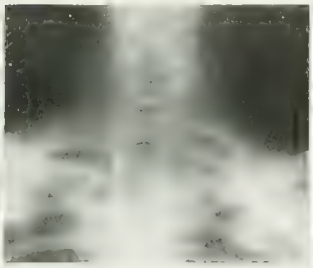


Fig. 4.

Fig. 5.

Fig. 3. W. C. No. 5, male, age 32. Medical student. The lungs show some peribronchial thickening. Considerable markings at both apices. Slightly greater density of left apex. Hilus on right enlarged and increased in density. Cervical rib on right. Questionable tuberculosis.

Fig. 4. Case 1453, female, age 27. Clinical diagnosis: question of pulmonary tuberculosis. No symptoms or evidence of cervical rib. X-ray examination showed complete seventh cervical rib on the left side, rudimentary rib on the right side.

Fig. 5. O. E. S. No. B315. Male, age 26(?), second lieutenant, Quartermaster's Corps. Thorax symmetrical. Diagnosis: Pulmonary congestion; bronchitis; questionable light bronchopneumonia, left base; pleural diaphragmatic adhesions; cervical ribs.

Most cases are reported as being between the ages of 20 and 30 years. Streissler's table of age incidence is as follows:

Years	Cases	Percentage
0 to 10	11	7.7
11 to 20	46	32.2
21 to 30	43	30.0
31 to 40	19	13.3
41 to 50	16	11.2
51 to 60	6	4.2
61 to 70	1	0.7
Over 70	1	0.7
	143	100

Age is of little importance in diagnosing the condition unless the associated lesion and cause of the occurrence of symptoms are added.

Cervical ribs occur more commonly in females, but here again is a divergence of opinion as to the exact ratio. Streissler in 200 cases found women affected in 70.8 per cent and men in 29.2 per cent. Church says between 60 and 70 per cent occur in females. Keen reported that in 41 cases, it occurred 75.6 per cent in females and 24.4 per cent in males. In another group of 19 cases, 11 were in females and 8 were in males. In the group reported here 12 are women and 9 men. In the rib anomaly cases reported here, the condition (see List No. 4) was found only in males, but I do not mean that such anomalies do not occur in females; it occurs, however, more frequently in males.

Authors are all agreed that cervical ribs occur more commonly bilaterally. It is difficult to determine, however, from the literature whether the condition was the same on both sides. From cases observed here (see tracings), the same changes are rarely seen on both sides, and the fact that symptoms occur more commonly unilaterally indicates a revision of this positive assertion. Pilling and also Tilmann reported 67 per cent as occurring bilaterally and 33 per cent unilaterally. Miller states that they occur bilaterally in 80 per cent of cases. Keen states that up to 1894, it was believed to occur bilaterally in two-thirds of the cases. If true cervical ribs are considered and are included with rudimentary tubercles or prominent processes, then the figures may be correct, but, if true cervical ribs alone are included, then undoubtedly an error is made. The symptoms are unilateral in 95 per cent of cases, and more commonly on the left. This has not been explained.

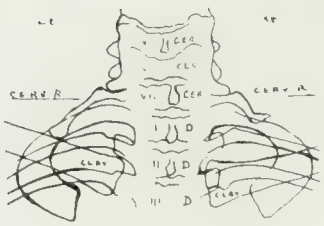
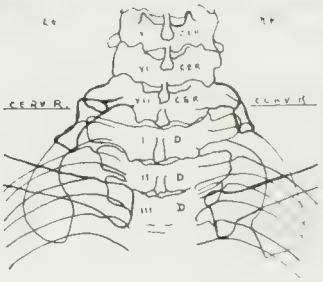


Fig. 6.



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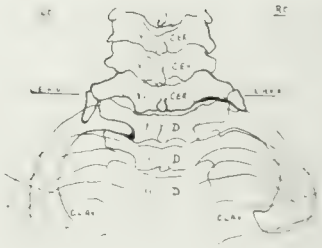


Fig. 8.

Fig. 6. V. L. Case 4027, female; age 40; occupation, housewife. The patient was born in Italy, is married and has had fourteen children. Two died from causes unknown. The other twelve are healthy. Eighteen months ago the patient suffered pain in the right shoulder radiating to the fingers. She also had pain in the right knee, dull aching in character, which she calls "rheumatism." Fifteen years ago the patient had an operation on the right side of the neck, which was probably for glands.

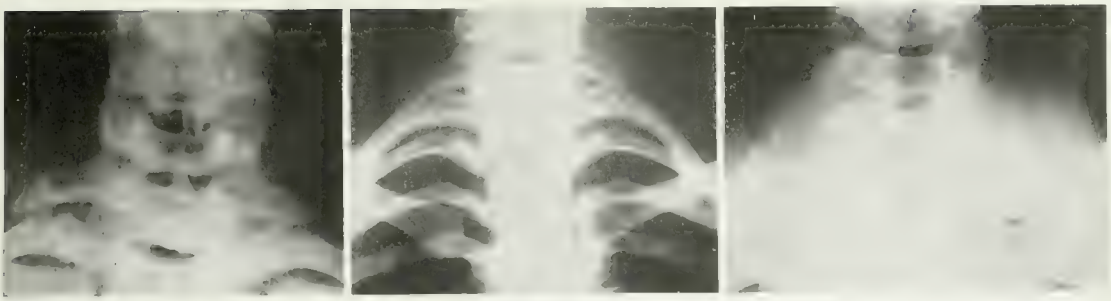
Fig. 7. Case 2144. A. R., male, age 27. May, 1918. The patient had pain in the left leg, duration 2 weeks. There was numbness and the leg was cold, and these symptoms were worse in damp weather. A hard nodular tumor is felt in the right cervical region. The patient complains of slight pain in this region at times.

Fig. 8. Case 1033. J. C., male, age 21. February, 1916. About 3 months ago, while at work, the patient felt a tingling sensation through the extremities and body. The extremities were cyanosed and cold. The feet were swollen at first. There was numbness in the region of the heart. A high arched, abnormal protuberance can be felt on each side of the cervical spine. The thyroid is rather enlarged.

To appreciate more fully the origin of cervical ribs attention is drawn to the embryonic and developmental considerations of this condition (Fig. 17).

Keen states very briefly that a cervical rib is only an abnormal deviation of a normal portion of a vertebra. We are apt to forget, he says, that in the cervical, the lumbar, and even in the sacral region there exists a representation of that which in the dorsal region is fully developed into a normal rib. It is well known that there are greater variations in the last three thoracic ribs and in the transverse processes of the lumbar region than there are in the cervical region. Therefore it has been thought that the law of compensation plays a part, so that broadly speaking when the twelfth thoracic ribs are absent seventh cervical ribs are provided. Unfortunately, although there are some interesting cases of variation and compensation, the exception to the rule is frequently found. Capitan, Todd, and others have been interested in determining what the cause is of these supernumerary ribs and what factors play a part in their production. From a purely evolutionary point of view, cervical ribs are of some significance.

Tredgold believes that additional ribs are due to the persistence of a former condition and that a decrease is simply a part of that steady progressive change which has been seen to run right through the order. Therefore, it is seen that a gradual but marked reduction takes place in the total number of ribs as we rise in the animal scale. To bear this out, Tredgold published tables of other investigators which show that, for instance in man, the eleventh and twelfth thoracic ribs are frequently rudimentary. In



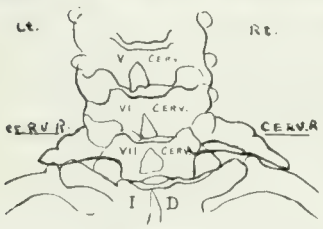


Fig. 9.

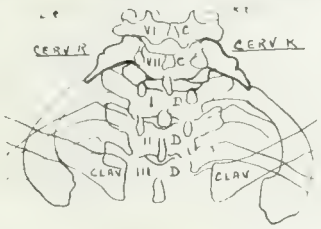


Fig. 10.

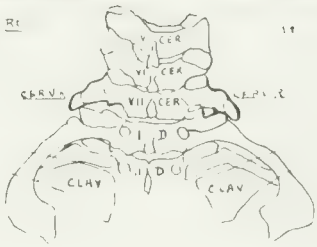


Fig. 11.

Fig. 9. Case 205. C. F.; age 24; occupation, driver. June, 1914. One week ago while wrestling with a man weighing 175 pounds, the opponent fell on him doubling his neck forward until there was a sharp crack. Since then he has been able to move the neck but very slightly. Roentgen diagnosis: cervical rib on both sides.

Fig. 10. Case 1295. J. W., female, age 18. The symptoms and details of the case are not known. Roentgen diagnosis: rudimentary seventh cervical rib.

Fig. 11. Case 597. D. S., female, age 32. March, 1915. The patient complains of numbness in the tips of the three lateral digits of the right hand. In March, 1916, the patient was operated upon for cervical rib on the right side. The rib was removed and later pain and paralysis appeared. In March, 1917, the patient was operated upon for sarcoma in the right axilla. A tumor was found under the pectoral muscle extending into the axilla. At that time there was complete paralysis of the right upper exremity.

the chimpanzee the twelfth and thirteenth are poorly developed and in the lemur the thirteenth to the sixteenth which is the last rib, are poorly developed. Capitan points out that birds like ostriches have cervical ribs and that the dolphin and porpoise have developed cervical ribs with projections articulating with the first thoracic rib. It is interesting to note, therefore, that in man the embryo has 29 pairs of rudimentary ribs and that consequently 17 pairs disappear before birth. All the cervical vertebræ naturally then have rudimentary ribs and it is the seventh cervical rib which is the last to disappear in fœtal life. If we start to reason from this point we are face to face with the fact that here something happens to prevent the retrogressive changes from taking place. Todd believes that it is an interference in absorption but also that the disappearance of the seventh cervical rib may be due to pressure of nerves and consequently atrophy of the compressed tissue. Todd also states that the vessels have equal importance with the nerves as causative factors in those modifications of the upper end of the thorax which are represented by the pressure of rudimentary ribs. This, however, would not account for the disappearance of the fifth and sixth cervical ribs. We know, of course, that the rudimentary rib is grooved for artery and nerve, and, as Todd points out, this is most marked in fœtus and in cervical ribs, least apparent in the adult and in an intermediate condition in the child.

Dwight suggested that the principle underlying these variations is the movement of the whole thorax upward or downward on the vertebral column.

Capitan reiterates that it is merely a progressive evolution, pointing out that the thorax is reduced at its two extremities. Cervical ribs, therefore, may occur on both sides and cases have been reported as high as the third cervical rib. The ribs themselves may be *reduced* to mere tubercles on the

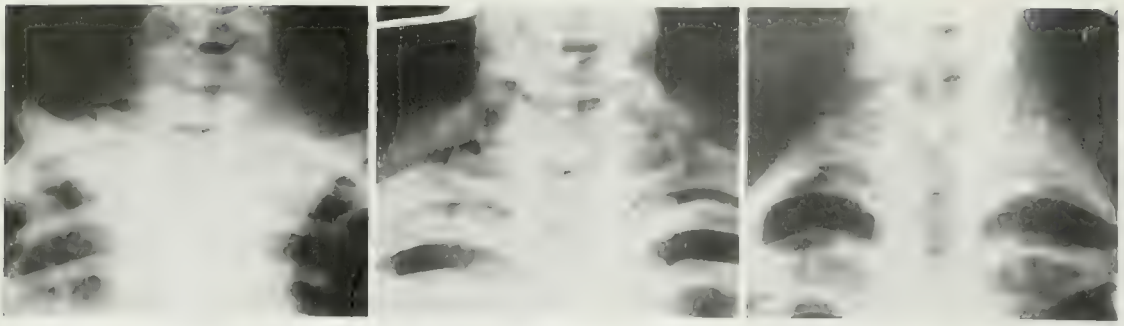


Fig. 12.

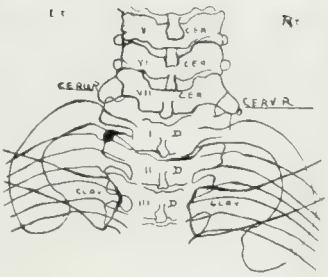


Fig. 13.

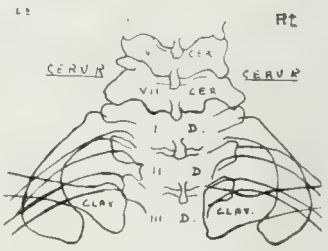


Fig. 14.

Fig. 12. Case 3595. M. D'A., female; age, 30; occupation, housewife. August, 1919. Clinical diagnosis: polyarthritis, hydrothorax, etc. No symptoms of cervical ribs. X-ray diagnosis: the seventh cervical vertebra shows rudimentary cervical ribs, bilateral.

Fig. 13. Case 1502. I. G., female; age 32; occupation, housewife. January 5, 1917. There was pain in the left forearm which had been present two weeks. She gave no history of injury except that she struck her thumb a month ago. A large mass resembling a tip of a cervical rib was felt in the supraclavicular space. Pressure at this point accentuated pain down the arm.

Fig. 14. Case 1952. C. M., female; age 31; occupation, housewife. February 29, 1912. The patient complains of numbness and tingling in the left hand, which she has had since last October. She has had the same sensation in the right hand but it has not been as severe as in the left hand.

transverse process, or there may be distinct *hypertrophy* of the transverse processes. In conclusion, therefore, the evidence as to cause and influencing factors has not been convincingly presented from a point of view of histology and a very interesting problem lies before the student.

The cases presented here have been divided into two classes: those that may be considered true cervical ribs, articulating as do the thoracic ribs with the transverse processes and those that may be considered rudimentary only. These are seen in Lists Nos. 1 and 2.

Although Gruber's classification of cervical ribs is apparently well known, there is little indication in the literature to show that it has been followed. Gruber divides cervical ribs into four classes, mainly according to size and therefore growth, as follows:

Class 1. Consists only of a node, which does not extend beyond the lateral dimensions of the transverse processes of the vertebræ.

Class 2. A blunt projection of bone 4 to 5 centimeters in length.

Class 3. A rib which extends far enough forward to articulate with the first rib or even to be attached to the sternum by a ligamentous band.

Class 4. A complete rib having vertebral origin and costosternal cartilage.

LIST NO. 1.—CERVICAL RIBS

1. W. C. Case No. 5. Typical seventh cervical rib on right, approximately one-half the width of first thoracic rib and extending forward one-half its length.

2. O. E. S. Case No. B. 315. Typical seventh cervical ribs, of same size and length on both sides, approximately one-half the size and length of first thoracic rib.

3. V. L. Case No. 427. Typical seventh cervical ribs on both sides, approximately one-third the length and size of first thoracic rib. The right differs from the left.

4. A. R. Case No. 2144. Poorly developed seventh cervical ribs on both sides, the right is not as well developed as the left.

5. J. C. Case No. 1033. Poorly developed seventh cervical ribs on both sides.

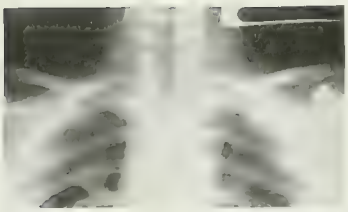


Fig. 15. Case 3400. S. R., age 9; female; occupation, school girl. August 28, 1919. No clinical diagnosis. The patient has had a cough since April, 1919. Three days ago she began to have a headache and pain in the left side, with numerous moist râles at both bases. Diagnosis: acute bronchitis. X-ray examination: The transverse processes of the seventh cervical vertebra are unusually prominent. They project at right angles. At the end of each transverse process there is a small rudimentary rib. Do not give rise to any symptoms at present.

6. XX. Complete seventh cervical rib on the right, as well developed as the first thoracic rib. A small bony tubercle on the left.

7. F. Case No. 1453. Complete seventh cervical rib on left. A rudimentary seventh cervical rib on right.

8. C. Case No. 3025. Complete seventh cervical rib on right. A small rudimentary rib on left.

9. B. Case No. 3446. Complete bilateral seventh cervical rib. On left sternal articulation. On right unusual articulation.

LIST NO. 2.—RUDIMENTARY SEVENTH CERVICAL RIBS, TUBERCLE FORMATION

1. I. G. Case No. 1502. Shows a small bony tubercle on right transverse process, seventh cervical vertebra. Transverse process on left is prominent.

2. C. F. Case No. 205. Very large bony outgrowths both sides on transverse process of seventh cervical vertebra.

3. D. Case No. 4167. Sharp bony outgrowths both transverse processes, seventh cervical vertebra.

4. D. Z. Case No. 1103. Many small irregular bony outgrowths on transverse processes seventh cervical vertebra.

5. M.D'A. Case No. 3595. Rather marked bony outgrowths on transverse processes seventh cervical vertebra.

6. J. S. Case No. 1212. Small bony tubercle on right transverse process, seventh cervical vertebra. Transverse process large on left.

7. D'S. Case No. 597. Prominent bony outgrowths on transverse processes of seventh cervical vertebra.

8. J. W. Case No. 1204. Well-marked bilateral outgrowths articulated on right, seventh cervical transverse process.

9. S. R. Case 3400. Bilateral prominent outgrowths on seventh cervical transverse process.

10. E. St. J. Case No. 3751. Small outgrowths on both transverse processes of seventh cervical vertebra.

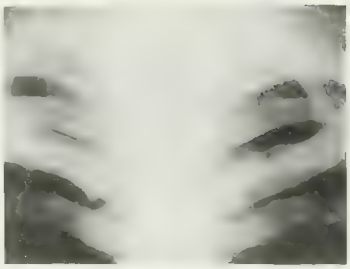


Fig. 16. Case 469. S. R. V., male, age 26 (?). July 14, 1919. Diagnosis: pulmonary tuberculosis. There were no symptoms suggestive of cervical ribs. The roentgenograph shows the first rib on the right to be approximately the same length as the left first rib, but its width is much less, being 0.7 centimeters on right and 1.3 centimeters on the left. There is a fusion of the distal end of the first to the second rib in the midclavicular line. There is slight asymmetry of thorax.

11. P. Case No. 3826. Rudimentary ribs, both sides, seventh cervical vertebra. Left more prominent, approximately 1.5 centimeter; right 1 centimeter. Definite outgrowths from transverse processes not articulated. Questionable pulmonary tuberculosis—no symptoms.

12. O'C. C. Case No. 3781. Rudimentary tubercle 0. 5 centimeter left transverse process seventh cervical vertebra. Right transverse process prominent. Space on left considerably narrowed. Patient with bone syphilis with diagnosis also of questionable cervical Pott's. No symptoms.

If a division is made of the cases described here according to Gruber's classification we have the following results: in Class 1, 8 cases; in Class 2, 4 cases; in Class 3, 5 cases; in Class 4, 4 cases.

In List No. 1, 9 cases of cervical ribs are given. In one case a positive diagnosis was made. In 3 of the cases there were no indications or symptoms of cervical ribs even after this condition had been determined. In the remaining 5 cases the diagnosis had not been made, although some of the symptoms referred to the cervical region. In 3 of the cases there was also a diagnosis of questionable pulmonary tuberculosis. In two of the cases, Nos. 3025 and 1453, the question of it being a rudimentary first thoracic rib was debated for a considerable time. This bears out the statement of the difficulties encountered in making a differential diagnosis between a cervical and a first thoracic rib; for comparison a case of rudimentary first thoracic rib is shown, Case No. 469. If the thorax is long, narrow and the apices

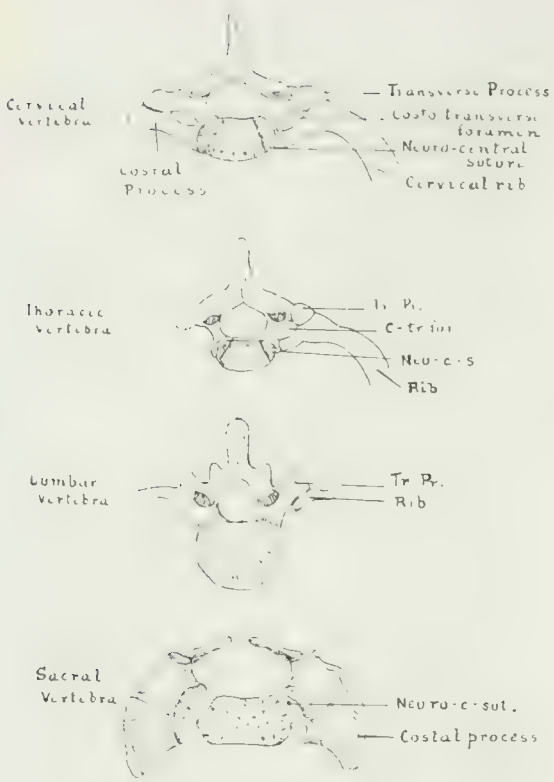


Fig 17. Morphology of the transverse and articular processes (*Morris*).

"The sixth, seventh, and possibly other cervical vertebræ present an additional center on each side of the neural arch for the costal process; it appears before birth . . . The costal processes of the seventh cervical not infrequently fail to ankylose with the vertebra; when this is the case, the processes become cervical ribs. Sometimes these ribs are of large size." (Henry Morris.—*Human Anatomy*. 1803, p. 38.

arched and also if the thorax is asymmetrical the diagnosis becomes the more difficult.

Among the 12 cases of rudimentary cervical ribs, List No. 2, various stages of development are shown. Two cases are of especial interest. The first, Case No. 597, was operated on and the rib removed. It is unlikely, in view of the facts as presented today, that the processes could have caused the symptoms thought to be due to pressure on the nerves by the seventh cervical ribs. The case proved to be one of malignant disease, the tumor mass being in the right axilla, exerting pressure on the brachial plexus. Operation on the cervical region did not relieve the symptoms and subsequent examination revealed the sarcoma. This is presented to demonstrate again the difficulties of diagnosis. Three cases gave a history of tingling sensation in left hand and numbness, but no diagnosis of cervical rib was made or was justified.

In two cases, a cervical rib was suspected and in one of these cases the hands were cold and blue as far as the wrist, with lack of sensation. The patient was 14 years of age and gave no history of trauma.

In one case a history of trauma was given. The patient, a man of 24, was injured while wrestling. An injury to the shoulder was suspected but radiological examination showed it as being within normal limits.

In the last 5 cases of the series there were no symptoms, the condition being found on examination of the lungs in 4 cases and of the vertebral column in the other.

These cases are more interesting from a point of view of symptoms, because it is difficult to determine whether the degree of growth is sufficient to produce pressure symptoms. Case No. 1103 shows no evidence of cervical rib, but there are numerous small exostoses indicating an inflammatory condition, which may be grouped under conditions of scalene exostosis and without doubt are sufficient to produce symptoms likely to be considered as caused by cervical rib. Then in this group there are cases with projecting processes or transverse processes that may easily give rise to symptoms in case of injury. The spaces between seventh cervical and first dorsal being considerably decreased, any inflammatory reaction in that vicinity would cause sufficient pressure to give rise to cervical rib symptoms.

Among the 17 cases presented in List No. 3 under suspicion of having cervical ribs, cases with more or less typical symptoms and history, no evidence was presented on radiological examination of such a condition existing. Two of these cases are given, to illustrate more fully the type of history given and symptoms which are considered as probably due to cervical ribs.

Case 1. C. R. No. 3127; female; age 19; occupation, school girl. Physical diagnosis: Cervical ribs. Complaint: Painful, swollen, discolored left arm.

Fig. 18. Anatomical specimen of seventh cervical ribs.

Present illness: Onset since birth. The patient has had attacks as follows: She will go to bed feeling good and apparently healthy and in the morning awake complaining of throbbing pain, steady and dull in character, beginning in left arm and running down the arm to the forearm and fingers but not radiating to shoulder. The arm cannot be moved or flexed at the elbow; the swelling is most marked below the elbow but to some extent in the arm and shoulder. The arm is very tender and discolored to some extent all the time but more marked during an attack. These attacks come about 1 to 2 months apart, last 7 to 10 days and then the arm appears normal, without pain and with slight discoloration. During bad weather the attacks come oftener and are somewhat worse. The patient feels well and healthy except for these attacks and some pain in lumbar region. The pain in back has been worse the last six months. Ordinarily the patient is not nervous but has noted that she is much more nervous during attacks.

Past history. These attacks as described have occurred since birth. The patient has had rheumatic fever. She was very delicate as a child, has had a good many attacks of sore throat and tonsillitis. She has not suffered from arthritis. She has had some form of "heart trouble."

The patient's mother was diabetic, and at present is not very well. The father is alive and well. Two sisters and two brothers are alive and well. One sister died 10 years ago of chorea or rheumatic fever. Two sisters died in infancy. The family history reveals no tuberculosis, heart trouble, or kidney trouble.

Physical examination. The left upper extremity is held in semi-flexed position. There is no muscular atrophy. There is present marked varicosity from shoulder-joint to wrist. The elbow-joint is rather prominent and the forearm is bent slightly outward. The color is dusty and cooler to touch than normal. Active and passive movements are limited but possible, and normal extension is possible with some difficulty and pain. The skin of arm is very sensitive to touch and pressure produces pain.

The blood examination was negative. The urine examination was negative. X-ray examination reveals no evidence of cervical rib, although the transverse process of the seventh cervical is slightly more prominent than usual, especially on the right.

Case 2. A. C. L., No. 470D, male, age 42. February, 1915. Complaint: has no use of right forearm. The patient first noticed trouble in his right hand in 1914. The weakness and pain in the hand and wrist were accompanied with prickly feeling in all the fingers. In June the patient placed the weight of his body on the right wrist which gave way causing pain. Since then pain has extended throughout the whole upper extremity which has grown weak and thin. Now he has pain in his right shoulder and when attempting to lift the arm there are creaks heard in the shoulder-joint. Nine years ago the patient dislocated the right shoulder. He complains also of cramps in the right leg.

Physical examination. The middle portion of right trapezius muscle measures less than the left. The deltoid is firm but small. The biceps are firm but small. The forearm feels cool. The grip is weak. No pain is present in the nerve trunks. Incomplete wrist-drop is noticed. He cannot lift his hand to the horizontal. There is atrophy of the hand. The thenar and hypothenar areas are not much affected. There is slight spasticity of the right forearm. Pain is produced on deep pressure of the fourth to sixth dorsal spines. Knee-jerks are increased on right. There is a tendency to ankle clonus on the right.

Subsequent history, February 8, 1915. The patient noticed tingling and numbness involving the right side of the face and the right side of the neck and shoulders, also the right arm. Three weeks later he noticed weakness of the right arm and hand. Pain was also present in the triceps muscle especially after work. The pain was continuous, worse at night, and increased on motion.

X-ray examination reveals no evidence of cervical ribs.

LIST NO. 3.—NEGATIVE CASES

Histories given with typical symptoms suggesting cervical rib.

1. V. E. Case No. 1119. Negative seventh cervical vertebra. Question, however, of transverse processes of sixth cervical vertebra.

2. H. A. Case No. 1605. Somewhat prominent transverse processes especially on right, of the seventh cervical vertebra.

3. I. D. Case No. 1958. Fairly prominent transverse processes seventh cervical vertebra.

4. J. C. Case No. 1926. Slight prominent transverse processes seventh cervical vertebra.

5. J. S. Case No. 939. Broad and slightly prominent transverse processes seventh cervical vertebra.

6. H. M. Case No. 2560. Prominent transverse processes seventh cervical vertebra.

7. C. D. Case No. 1763. Transverse processes seventh cervical vertebra unusually long especially on left.

8. A. C. L. Case No. 470. Seventh cervical vertebra negative.

9. J. S. Case 1212. Prominent transverse processes especially on right of seventh cervical vertebra.

10. D. S. Case No. 597. Very prominent transverse processes especially on left of seventh cervical vertebra.

11. C. M. Case No. 1952. Prominent transverse processes of seventh cervical vertebra.

12. D. Z. Case No. 1103. Very slight prominence of transverse processes seventh cervical vertebra. There is, however, considerable irregularity and roughening of distal surfaces.

13. M. H. Case No. 3441. No evidence of cervical ribs or prominent transverse processes.

14. C. R. Case No. 3127. Transverse processes, especially on right, of seventh cervical vertebra are slightly prominent.

15. E. A. Case No. 918. Negative for cervical ribs.

16. J. H. Case No. 1414. No cervical rib. Prominent first thoracic rib on right and very prominent seventh cervical transverse processes.

17. J. R. Case No. 3260. Negative. Rudimentary first thoracic rib on left.

LIST NO. 4.—THORACIC RIB ANOMALIES

All Male Patients

1. S. R. V. Case No. 469. On right, fusion of first to second rib. First rib on right is much narrower than the first rib on left. Thorax slightly asymmetrical. (Fig. 16.)

2. M. T. Case No. 793. On right, a bifurcation of third rib from midclavicular line to costal end; bifurcation approximately 5 centimeters in length. Ribs well formed. Thorax symmetrical.

3. B. Case No. 720. On right, fusion of first to second rib. Fusion complete from articulation to within 2 centimeters of costal end. Combined width is 4 centimeters as compared to 1.5 centimeters of the first rib on left.

4. F. H. Case No. 434. On left, first rib undeveloped, is 5 centimeters in length, apparently not fused to second rib. The first rib on right is 10 centimeters in length. Thorax symmetrical.

5. C. Case No. 252. On left there is fusion of the first with the second rib at its middle portion. The ribs run down parallel with the vertebral column.

6. Z. Case No. 149. On left, fifth rib, midclavicular line, is bifurcated.

7. T. Case No. 995. On right, fourth rib, midclavicular line, is bifurcated.

8. F. Case No. 663. On right, fourth rib, midclavicular line, is bifurcated.

9. M. Case No. 676. On right, fourth and sixth ribs are bifurcated. On left, midclavicular line, fifth rib is bifurcated.

10. S. Case No. 843. On left, fourth rib, midclavicular line, is bifurcated.

11. W. Case No. ———. On right, fourth rib, near anterior axillary line is bifurcated.

12. M. Case No. 435. On right, first rib is considerably decreased in size.

13. J. R. Case No. 3260. On left, a rudimentary first thoracic rib.

Since completing this paper two other cases with especially typical history and with marked unilateral nerve and vascular symptoms of cervical rib pressure have proven to be negative.

The last group of cases, List No. 4, with 13 cases, is included only because of its interest, the anomalous condition of first thoracic ribs has of course an especial interest, and secondly because they were rib anomalies that had no co-existing anomalous condition in the cervical region. None of these cases gave symptoms. In all 21 cases of cervical ribs and 13 of rib anomalies, no co-existing anomalous conditions were found. Another interesting anomalous condition was found in the case of a patient who had a bifurcated spinous process of the third cervical vertebra. Finally, it may be pointed out that variations in the eleventh and twelfth dorsal and in the transverse processes of the lumbar vertebræ have been observed a great many times and that several cases with six lumbar vertebræ have also been seen. With the exception of symptoms arising from pressure on the transverse processes of the fifth lumbar vertebra, no cases presented any symptoms referable to these anomalies.

Specimen rib. The rib is in the osteological collection of the Yale School of Medicine; its history, however, is unknown. The length of the rib is 9 centimeters but the ventral 4.5 centimeters are fused with the superior surface of the first rib, the fusion beginning 1 centimeter anterior to the tuberosities, thus making the first rib bicipital. Although fusion is complete, except for the posterior centimeter, nevertheless the body

of the cervical rib is demarcated laterally by a slight groove running almost its entire length and medially by a shallow groove 1 centimeter in length at the ventral end, so that the outline of the body of the cervical rib is indicated by an elevated area and the grooves just mentioned. The body, which posteriorly is 7 millimeters vertically in thickness and 13 in breadth, tapers ventrally and reaches the posterior edge of the groove for the subclavian artery. On the superior surface an oblique groove 2 centimeters in length runs forward from the tuberosity to the medial edge. The significance of this groove is not evident. The ventral end of the rib undoubtedly gave attachment to part of the scalenus medius muscle.

The head of the rib begins 7 millimeters lateral to that of the first rib and is rounded, resembling the head of the first rib. It shows a single articular facet which looks upward, backward, and medially, while that of the first rib faces somewhat downward. The head of the first rib, judging by the appearance of the facet, articulated with the centra of both the seventh cervical and first thoracic vertebræ.

The neck is 3 centimeters in length, somewhat rounded near the head but enlarging, and acquires a breadth of 15 millimeters near the tuberosity. It lies 7 millimeters above and parallel to the neck of the first rib, which it resembles in shape, size, and appearance. The upper and lower surfaces are rough and porous.

The tuberosity of the cervical rib is larger, more knob-like and prominent than that of the first rib and projects more dorsolaterally. The articular facet, larger than that of the first rib, is slightly convex and triangular in outline, with the apex directed medially and looks backward and medially as does that of the first rib.

It is altogether probable that a cervical rib of this type would not produce either motor, sensory, or vasomotor disturbances or interfere particularly with the apical expansion of the lung.

These cases were obtained from the New Haven Dispensary, New Haven Hospital, and the U. S. Army General Hospital No. 16.

In conclusion, I wish to thank Miss M. A. J. Barrett for her kindness and generous assistance in looking up the cases and Mr. Earl Furbush for the trouble and interest he has taken with the roentgenographs and photographs. I am indebted to Dr. H. B. Ferris of the Department of Anatomy for the excellent description of a right cervical rib, illustration of which is given here.

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BRACHIAL BIRTH PALSY AND INJURIES OF SIMILAR TYPE IN ADULTS[1]

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THIS presentation will be limited to a discussion of the lesions of the "obstetric palsy" type and the precisely similar lesions which occur in adults under the name of "Erb's palsy." The subject is again brought forward because of the widely divergent opinions which prevail in different groups of the profession, as to the etiology, pathology, and especially as to the best form of treatment in these cases. First the birth palsy group will be discussed

Nearly all neurologists and pediatricians, and they are the ones who first see these cases in infants, believe and state that spontaneous *cure* will occur in practically all cases after a sufficient interval of time provided proper care is given.

Personal experience, extending over some sixteen years, has thoroughly convinced me that the majority do not obtain a perfect recovery no matter how much time elapses and no matter what systematic treatment is given. Even surgical repair of the damaged nerves seldom gives a perfect physiological recovery.

The majority of these cases occur in the children of the poor. They are bound to become cripples in greater or less degree and to remain a burden to the family and a tax on the community. It is, therefore, important both for the child and the community that there should be some consensus of opinion among the various branches of the profession as to what constitutes the best system of treatment for these children.

The question at issue, then, is whether repair of the nerves gives average results so much superior to those following any other form of treatment that surgical interference should be given the preference. Before arguing this question it is necessary to present certain material as a basis for the deductions to follow.

To digress for a moment, the discussion would not be complete without mentioning the radically different views of T. T. Thomas, of Philadelphia, who maintains that obstetric palsy is not a nerve lesion primarily but rather an injury of the shoulder-joint capsule associated with subluxation of the shoulder and often with a secondary infiltration of the plexus nerves. Following the presentation of his paper, the careful examination of a number of very young infants with obstetric palsy elicited the following facts: No infant under three weeks of age showed any degree of the posterior subluxation supposed to be the cause of the palsy. The subluxation appeared at any time from three weeks to several months after birth and gradually increased in degree. In one case operated upon the subluxation gradually disappeared as the nerves and muscles resumed function.

Moreover in a number of cases operated upon the upper roots of the plexus were torn across and the ends displaced; in others, one or more roots were avulsed from the cord, and in none of these cases was there any continuity between the cicatricial mass about the nerves and the capsule of the shoulder-joint. These few briefly-stated facts would seem to indicate that the essential lesion was not damage of the shoulder capsule, but rather a true nerve lesion It is imperative to be right on this matter in order to have a correct basis for treatment.

Assuming then that the lesion is intrinsically of the nerves, the following brief statements are pertinent: The sole cause of the nerve damage is overstretching caused by separation of the head and shoulder on the paralyzed side. From the anatomical disposition of the nerves, the upper roots get the strain first; after they begin to yield the lower roots get it. For this reason the palsy is most marked in the upper root zones. The roots may be slightly overstretched causing temporary palsy followed by rapid recovery. The roots may be entirely torn across and the ends displaced. Between these two extremes there

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may be any number of variations so that no two cases are likely to be of exactly the same severity. The lesion may involve part of one root, or all five roots or any variation between these two extremes. The lesion may be at the origin of root from cord "avulsion of the root" or it may be at the lower portion of the plexus or at any site between these extremes. In addition to the intrinsic nerve damage, there is present, in all but the mildest cases, tearing of the deep cervical fascia just anterior to the plexus, and also of the scaleni muscles.

There is present, then, torn fascia, torn muscle, torn nerve sheath and torn nerve, all infiltrated with blood from the torn vessels. As time passes a hard cicatrix binds all these structures together and forms an impassable barrier to regenerating nerve and to nerve impulses.

In addition to these immediate pathological consequences there are certain secondary pathological sequelæ if nerve repair does not occur. In the majority of cases the muscles are paralyzed in groups, resulting in characteristic attitudes of the paralyzed extremity as will be seen in the slides.

As time goes on the joint ends of the bones grow misshapen to accommodate these attitudes, the ligaments and muscles contract and finally we have organic deformity replacing functional attitude.

Herein lies the strongest argument for early nerve repair, since these organic deformities have appeared in many cases despite the most persistent attempts to prevent them.

Symptoms. Just after birth in the majority of cases the extremity lies fully extended with marked inward rotation of the humerus and pronation of the forearm, so that the palm of the hand faces backward and outward. In severe cases there will be no movement of any portion of the extremity. In less severe cases there will be motion in the digits, and possibly in the hand and wrist. In mild cases there will be motion in the forearm, elbow, and possibly in some shoulder muscles, depending upon the number of roots involved and the degree of injury. The paralyzed muscles are in groups associated with the root distributions.

It must be remembered that the upper roots suffer first and most and the lower ones later and according to the degree of force involved, so that the upper one or two roots may be more or less completely and permanently damaged while the lower ones are merely overstretched. This corresponds with the clinical history of the majority of cases, in which, at first, there is complete loss of power, followed after a varying period by return of voluntary movement in the digits, then hand, wrist, etc., up to the level where the roots which have been permanently damaged prevent further recovery. This stage of recovery in the lower roots may extend over a period of two years, but meanwhile the complete loss of function in the upper roots leads to the development of the secondary pathological changes and organic deformities previously enumerated.

Proper appreciation of these facts is of great value in determining the method of treatment.

The usual underdevelopment of the shoulder girdle on the damaged side interferes with the child's balance and causes frequent falls.

Sensory disturbances are not marked as a rule. When the fifth and sixth cervical roots only are involved no sensory disturbances can be determined. In rupture of the entire plexus there is complete anæsthesia. Between these two extremes there are all grades of disturbance according to the lesion. The surprising absence of sensory disturbance is due to the interlacing of the sensory fibers of neighboring roots.

In practically every case the cicatricial mass previously mentioned can be felt over the nerve roots on the damaged side.

In adults, the Erb's type of paralysis is precisely the same as the birth palsy in etiology, pathology, and symptomatology with the exception that the developmental defects naturally do not occur in full-grown adults.

From the facts presented, one may proceed to the discussion of treatment upon which there is the widest divergence of opinion.

To those who say that operation is contraindicated because spontaneous recovery occurs in practically all cases, it is pertinent to

state that all orthopedic dispensaries have many of these children from 5 years of age upward who are seriously crippled. If the charge is made that they were not properly cared for it is only necessary to state that a number of children from 2 to 10 years of age have been brought for surgical repair after persistent and consistent treatment had failed to develop a satisfactory extremity. Surgical repair has been followed in most of these cases by comparatively prompt and very marked improvement.

Obviously there is a field for surgical nerve repair. In what cases and when is operative interference to be undertaken?

Perhaps a series of statements based upon personal experience will be the shortest way to a logical answer.

1. The great majority of cases do not get well spontaneously either with or without the best expectant treatment available.

2. The small minority of cases that do recover spontaneously are almost completely well at the end of three months.

3. Many of the cases operated upon have shown one or more roots torn across with the ends displaced; nerve roots avulsed from the cord; or damaged areas filled with very dense scar tissue. Such lesions do not recover spontaneously.

4. Clinically it is impossible to determine the precise nature of the lesion at an early period and its extent can be properly appreciated only after the lapse of one or two years. Meanwhile mal-development is occurring.

5. The earlier the nerve repair occurs whether spontaneously or with surgical aid, the more promptly will nutrition and function recover their balance and prevent the occurrence of deformity.

The question as to operation must also be influenced by the degree of intrinsic risk in the procedure.

Operation consists in an incision at the base of the neck through skin, platysma, and the underlying fat pad. When these are retracted the damaged nerves and adherent cicatrix are exposed. The various nerves are then dissected out and such repair work done as is found necessary. Ordinarily the amount of blood lost is very slight. In the very extensive cases, especially those involving the lower roots, there is occasionally a serious loss of blood from damage to one of the large veins. Aside from rare accidents of this kind there is no risk beyond that of the anæsthetic.

From the foregoing facts the only logical deduction is that surgical repair of the nerves is indicated in the great majority of cases and at an early period.

In cases which are obviously mild at the start one may expect a spontaneous recovery which will be nearly complete by the end of three months. Therefore operation is not indicated.

In the more serious group in which almost the entire musculature of the extremity is primarily paralyzed and the lower roots show no tendency to spontaneous recovery in the first few days, it is practically certain that a permanent lesion has occurred, at least in the upper one or two roots, and early operation is indicated.

Naturally in the still severer types of injury, early operation is indicated without question.

In the border-line cases, operation is more debatable and one must choose between early exploration and delay for three months to see what degree of spontaneous recovery will ensue.

If a case is explored and no nerve lesion requiring repair is found, the operation consists merely in an incision through the skin, platysma, and fat, examination of the plexus and closure of the wound. It is all finished in a few minutes. If a lesion requiring repair is found, valuable time is saved to the patient.

"Early operation" may be defined as one occurring in the first few weeks of life after the infant has become adjusted to its new world. This period therefore varies with the individual child, and with the judgment of the particular surgeon.

The disadvantages of operation in very early infancy lie in the very small field and small nerves which make the technical part of the suture more difficult. On the other hand the dissection is easier because the cicatricial tissue has not become so dense.

All things considered, experience may eventually indicate that the best results will follow operation at about three months of age.

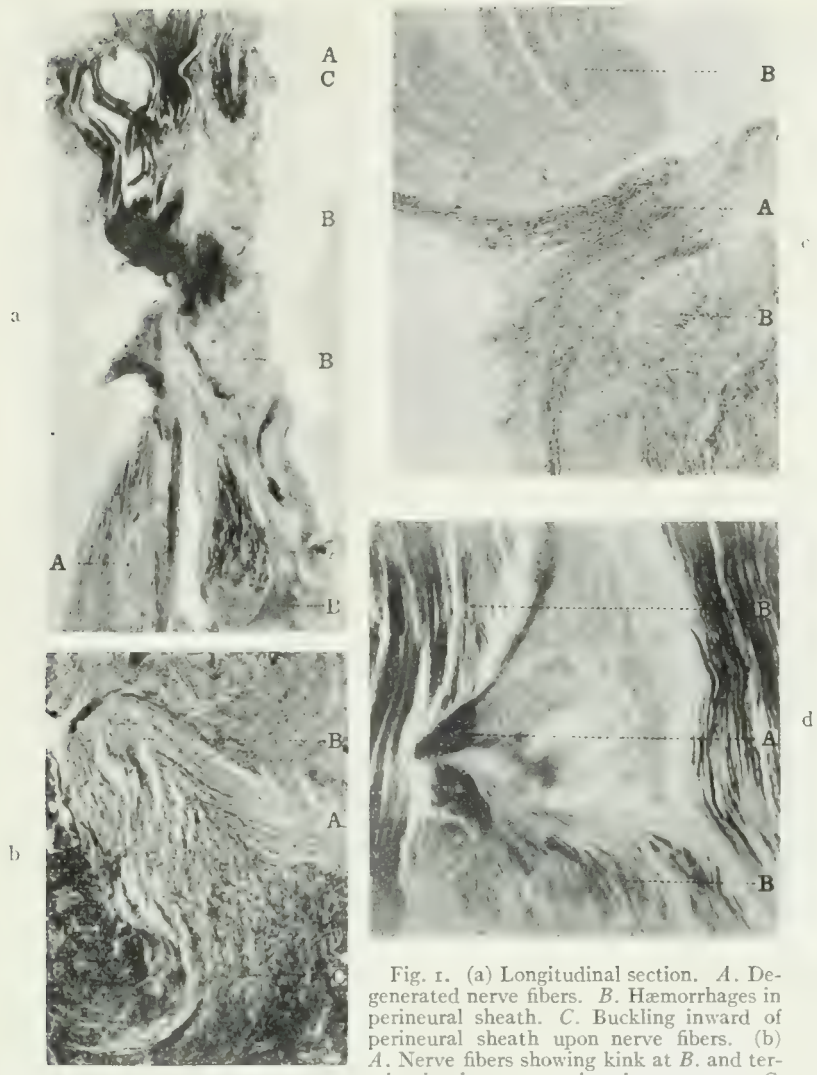

Fig. 1. (a) Longitudinal section. *A*. Degenerated nerve fibers. *B*. Hæmorrhages in perineural sheath. *C*. Buckling inward of perineural sheath upon nerve fibers. (b) *A*. Nerve fibers showing kink at *B*. and terminating in a connective tissue mass at *C*. which contains blood clot. (c) *A*. Band of connective tissue constricting nerve bundle *B*. (d) *A*. Buckling of perineural sheath compressing nerve fibers. *B*. Broken up remnants of myelin sheaths.

In all cases, whether operation is to be considered or not, the extremity should receive systematic attention. It is of primary importance to retain the extremity in a position which relaxes the paralyzed groups of muscles. Abduction and external rotation of the upper arm, flexion of the elbow, supination of the forearm and hand, and extension of the wrist and fingers are indicated. This position may be retained by use of a brace such as is used by orthopedists in deltoid paralysis, and depicted later. Very young infants are intolerant of the fixation and their skin is sensitive. A good compromise consists in passing a loop of gauze about the wrist on the damaged side, pulling up the extremity until the hand is near the occiput and then fastening the ends of the gauze to the shoulder on the opposite side or to the clothing about it.

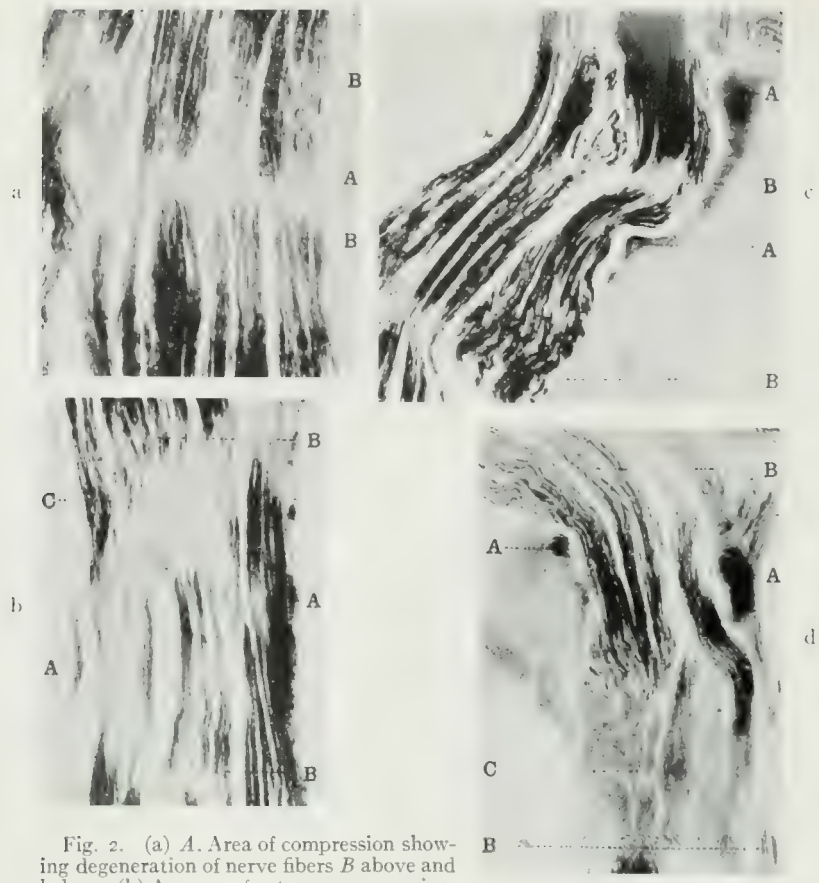

Fig. 2. (a) *A*. Area of compression showing degeneration of nerve fibers *B* above and below. (b) An area of extreme compression. *A*. Pigment from old hæmorrhage into perineural sheath. *B*. Broken up myelin sheath. *C*. Torn and compressed nerve fibers. (c) Buckling inward of perineural sheath with blood pigment deposits at *A*. Torn nerve fibers at *B*. (d) *A*. Pigment from old hæmorrhage into sheath. *B*. Myelin fragments. *C*. Torn and degenerated fibers.

Note: With the exception of (a) in Fig. 1 these specimens were all taken from cases that were several years old.

For the first three weeks no manipulation of the extremity is desirable, because it adds to the irritation already present in the damaged nerves and likewise to the pain.

After this period of irritation has passed, systematic physical therapeutics are essential both before operation and afterward, until such time as regeneration and return of function are nearly complete, a period of several years' duration.

In my cases, operated upon, the extremity is maintained in the desired position by a brace, for three months, after which physical therapeutics are systematically employed.

For the relief of the acquired deformities in the older children two procedures have been developed by orthopedists. The dislocation at the shoulder is the chief factor preventing good use of what is left of the extremity.

Dr. Whitman overstretches, under general anæsthesia, the shortened muscles and ligaments about the joint, and, when they are loosened up, reduces the subluxation. A plaster cast is then applied holding the extremity in an overstretched position for several weeks.

This is a very serviceable procedure. It requires considerable strength, skill, and

Fig. 3. Fig. 4. Fig. 7.

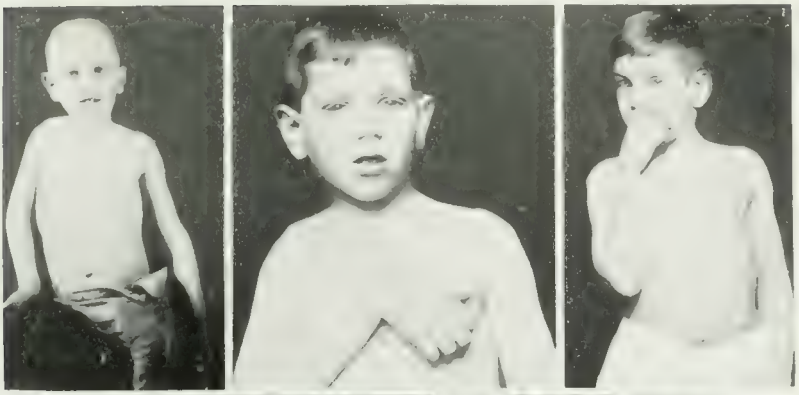

Fig. 5. Fig. 6.

Figs. 3 to 7 inclusive, are pictures of Case 3 in the operative series of birth palsy cases. This boy was 8 years old. He had a right birth palsy and had had intermittent treatment up to the time of operation.

Fig. 3 shows customary attitude, characteristic deformity of birth palsy type of serious degree. Useful function was extremely limited. The flexors of the fingers were fairly strong but the extreme flexion of the wrist neutralized the value of the hand.

Fig. 4 shows the limit of elevation of hand toward face before operation; also atrophy of deltoid.

Fig. 5 shows narrowness of the right shoulder girdle, under size of right scapula and marked posterior luxation at the shoulder.

NOTE.—Operation showed complete tearing apart of the fifth and sixth cervical nerves with dislocation of their ends from each other. The seventh cervical nerve was compressed and moderately damaged. The nerve ends were dissected free, sectioned transversely to remove scar tissue, and end-to-end suture done.

Fig. 6 shows markedly improved position and size of the right upper extremity 9 months after surgical nerve repair. (Compare with Fig. 3.)

Fig. 7 taken 31 months after surgical nerve repair shows flexion of the elbow, supination of the forearm, which was previously impossible, with approximation of the fingers to the face. (Compare with Fig. 4.)

judgment to overcome the contracture without fracturing the humerus, which in these cases is subnormal in size and strength.

There are two other drawbacks to this procedure. In many of these children the coracoid process becomes elongated and bent downward so as to furnish mechanical obstruction to complete reduction of the humerus. The coracoid process cannot be broken or displaced by manipulation. There is marked tendency to recurrence of the deformity the more so if the coracoid process

Fig. 8. Fig. 9. Fig. 10. Fig. 11.

Fig. 12. Fig. 13. Fig. 14. Fig. 15. Fig. 16.

Figs. 8 to 16 inclusive are pictures of Case 62 in the operative series of birth palsy cases. The child was five and a half years old and she had received persistent massage, passive motion, and muscle training from the time of birth to the time of operation.

Fig. 8 shows the characteristic attitude of the right upper extremity before operation. In this case there was marked interference with the value of the hand, the muscles of the fingers not being very strong.

Fig. 9 represents the limit of elevation of the hand to the face. It illustrates the characteristic deformity in these cases where inward rotation of the upper arm prevents proper elevation of the hand.

Fig. 10 shows the limit of forward elevation of the right upper extremity.

NOTE.—The Sever operation was done first. The fifth and sixth cervical roots were nearly torn apart with cicatricial connection between the torn ends. The seventh cervical root was torn half way across. The eighth cervical and first dorsal roots were not macroscopically damaged. All of the roots were compressed by thickened cervical fascia which was dissected away. The damaged nerves were resected and end-to-end suture done.

Fig. 11 shows the brace used during the 3 months following operation. This relaxes all of the paralyzed muscles and approximates the head and shoulder on the paralyzed side preventing tension on the nerve sutures. This brace is worn without intermission during the first 3 months after operation. In this case Sever's procedure was added to surgical repair of the damaged nerves because of the marked contraction of the subscapularis and pectoralis major muscles.

Figs. 12 to 16 inclusive were taken 6 months and a few days after operation.

Fig. 12 shows free abduction at the shoulder, external rotation of the arm, well marked supination of the forearm.

Fig. 13 shows natural carrying attitude of the right upper extremity. (Compare with Fig. 8.)

Fig. 14 shows the freedom with which the hand can be approximated to the face, elevation of the arm, flexion at the elbow, supination of the forearm.

Fig. 15 shows all of the previous types of motion, bringing palm of hand to top of the head.

Fig. 16 shows the rear view of the same attitude. This child before operation had never been able to attain the positions shown in Figures 14, 15 and 16.

hooks down to a marked degree and interferes with free and complete reduction of the shoulder. Dr. Sever attacks the same problem by section of the pectoralis major and subscapularis tendons by open operation. At the same time, if the coracoid is in the way, its tip can be resected subperiosteally and its obstructing portion removed. Reduc-

Fig. 17. Fig. 19.

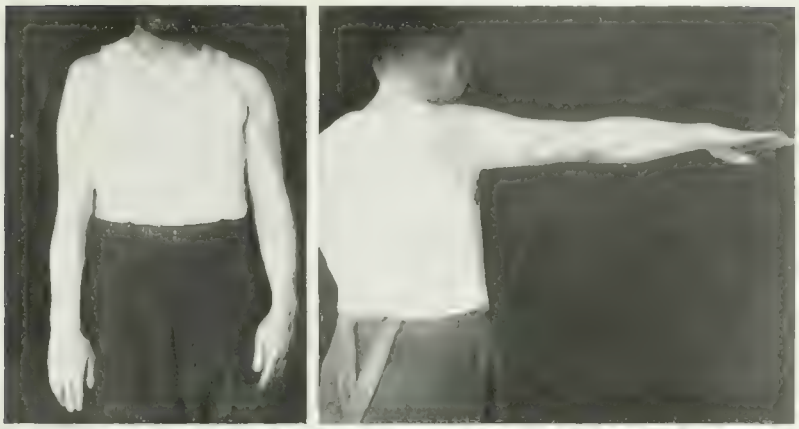

Fig. 18. Fig. 20. Fig. 21.

Figs. 17 to 21 inclusive are pictures of Case 9 in the operative series of Erb's palsy in adults. This man before operation had no power of flexion at the elbow and no supination of the forearm, but had fair mobility and slight strength in the digits and the wrist. He could elevate the extremity as a whole fairly well through the scapular muscles. There was little useful function in the extremity. These pictures were taken 9 months from the date of surgical nerve repair.

NOTE.—There was fracture of the right clavicle at its middle with marked overriding and excessive callus. The fifth and sixth cervical roots were torn and involved in scar tissue. The seventh cervical root was almost torn off and the remnant involved and distorted in the scar. The eighth cervical and first dorsal were simply compressed by scar tissue. The fifth, sixth, and seventh roots were resected and end-to-end suture done. The eighth cervical and first dorsal roots were merely released from compression.

Fig. 17 shows the natural attitude of the right upper extremity. Flattening of the deltoid is still obvious.

Fig. 18 shows strong flexion at the elbow and the making of a firm fist. There is also well marked supination.

Fig. 19 shows abduction at the shoulder without the scapula following the humerus too closely. There is free and normal motion at the shoulder.

Fig. 20 shows hand upon the back of the head which involves abduction at the shoulder, external rotation of the arm, flexion of the elbow and supination of the forearm, most of which had been previously absent.

Fig. 21 shows the same type of motion as in Fig. 20 resulting in carrying the palm of the hand to the face. All of these positions had been impossible preceding operation. To illustrate the degree of strength which had returned to the extremity he lifted a magneto weighing nearly ten pounds from the floor to a table about 30 inches high.

tion is then easy and there is no tendency to recurrence.

This operation leaves a fairly evident scar and the patient cannot afterward put the hand backward and upward to the scapula. Nevertheless other motions are so much more free as to render the net results a very great improvement. It is now my custom to combine this operation, in suitable cases, with nerve repair, in one sitting.

Final results in a considerable number of cases must be the criterion by which one method of treatment is judged to be superior to others.

My series of cases of birth palsy operated upon now totals 70. Of cases seen but not

operated upon because of refusal of parents or physician there were more than 130. Of these 200 only 10 were two months or less of age when first seen. Of these, only two made spontaneous recoveries; one complete by the end of three months and the other so nearly complete by the end of three months that operation was not to be considered. This 1 per cent of spontaneous recoveries is perhaps so small because the majority of cases were several months or more old and the time for spontaneous recovery had passed.

Of the 70 operative cases three died. The very first case died 20 hours after operation with a temperature of 107° F. The pathologist believed the case to be one of status lymphaticus.

The fourth case of the series developed a violent gastro-enteritis the day after operation and died a week later.

The sixty-seventh of the series died on the table from sudden severe hæmorrhage due to injury of one of the large veins at the base of the neck which was adherent to the dense scar tissue involving the whole plexus region.

FUNCTIONAL RESULTS

Concerning the functional results, there has been no perfect anatomical and physiological recovery. With a few exceptions, in which the damage has been found to be irremediable, these children have made marked improvement and many of them have attained almost perfect function in the extremity.

In a number of cases to be illustrated by slides physical therapeutics were relied upon by the parents and physician for a period of two to four years and when improvement had ceased for a long interval operation was done and the result was a marked improvement. This improvement therefore is solely attributable to the operation.

Of the Erb's type of paralysis in adults there were 14 cases operated upon. In 7 of these one or more roots had been avulsed from the cord, thus showing a much higher percentage of very severe injuries than occurs in birth palsies. The results were unsatis factory.

Of the remaining 7, 3 were lost to view. Of the remaining 4, 1 case made a perfect recovery, 1 made an almost perfect recovery, 1 made a good recovery, and 1 made a very little improvement probably because he removed his dressings, stretched his head and neck and probably pulled apart the sutured nerves.

There was no mortality.

RECURRENT VESICAL CALCULI ASSOCIATED WITH CALCULUS IN DIVERTICULUM AND CONTRACTURE OF VESICAL ORIFICE

By EDWIN G. DAVIS, M.D., F.A.C.S., Omaha
From the Department of Urology, University of Nebraska College of Medicine

OWING to recent advances in the methods of urological diagnosis, the frequency of vesical diverticula has come to be generally recognized. In marked contrast with the literature of 20 years ago, when the *Surgeon General's Index Catalogue* recorded less than ten publications concerning vesical diverticula, and about the same number of cases of sacculated bladder (most of these based on autopsy findings), is the voluminous literature of the present date upon this subject, containing contributions from many prominent surgeons and urologists. The etiology of diverticula has been widely discussed, and there have been plausible theories advanced to prove either their congenital or acquired origin. In lack of conclusive evidence, the most generally accepted view is that the primary cause is an embryologic defect, and that urinary obstruction may later play a part in development. It is also generally recognized that diverticula are found usually associated with obstruction of the lower urinary tract.

In view of this extensive literature, a case of simple bladder diverticulum is not of particular interest; and even cases of calculi contained in diverticula are not unusual. The case reported herewith is of unusual interest, however, in that the recurrent vesical calculi were associated with a residual urine due to a contracture of the vesical orifice, and in that it was definitely shown that the recurrent vesical calculi formed in turn upon a spicule projecting into the bladder from a calculus contained in a diverticulum.

The patient, a male, age 25, referred by Dr. LeRoy Crummer, complaining of dysuria, small stream, frequency, stoppage of urine, and general malaise and loss of weight, gave a history of four previous suprapubic cystostomies during the preceding 12 years. In two instances vesical calculi had been removed, and the other two were apparently merely

Fig. 1. Roentgenogram showing oval-shaped calculus with projecting nipple, lying far to the right of the mid line, and therefore presumably extravesical.

Fig. 2. Cystogram demonstrating that calculus shown in Figure 1 is extravesical and is contained in a diverticulum, which is connected with the bladder by a narrow isthmus.

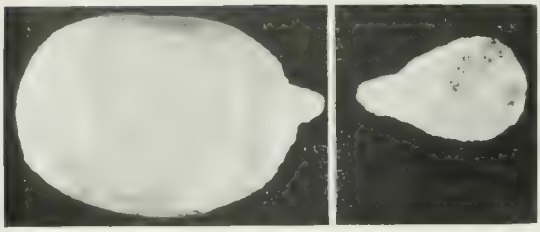

Fig. 3. Photograph of oval calculus with projecting nipple removed from the bladder by suprapubic cystotomy.

Fig. 4. Photograph showing shape and size of calculus removed from diverticulum. The projecting nipple shown in this calculus, and that on the calculus shown in Figure 3, were presumably at one time united, forming a dumb-bell shaped calculus contained partially in the bladder and partially in a diverticulum.

for drainage. After each operation the fistula was many weeks closing. There was a history also of marked difficulty in urination and small urinary stream since the patient's earliest recollection. The patient stated that as a boy his stream of urine was always smaller than that of other boys.

The striking feature in the history, upon which it was possible to base a snap diagnosis without examination, was the fact that after the first operation there was complete comfort for several months (except for small stream which he had had all his life) and that the old train of symptoms (pain, frequency, stoppage) *suddenly* recurred, almost instantaneously. At second operation the patient stated that a calculus was removed measuring 3 by 4 by 6 centimeters, oval in shape, with a projecting spicule on one end. This calculus had existed in the bladder for months without symptoms.

General physical examination was negative except that the patient was anæmic and showed signs of loss of weight. The external genitalia were normal. Suprapubic region showed extensive scar formation.

Rectal examination showed a small fibrous prostate and a moderate induration in the region of both seminal vesicles. The vesical diverticulum was not palpable.

The urine was foul-smelling and purulent, containing many pus cells and bacteria, no albumin. After intramuscular injection of 6 milligrams of phenolsulphonephthalein, 45 per cent was excreted during the first hour.

Cystoscopy showed the urethra to be normal. There was moderate obstruction to the cystoscope at the vesical orifice. Residual urine, 200 cubic centimeters. The bladder capacity was not limited. There was a high grade diffuse cystitis, the mucosa nowhere presenting a normal appearance. Lying on the floor of the bladder was a calculus, apparently about the size of a bantam's egg. On the right lateral bladder wall about 3 centimeters from the right ureteral orifice was the small orifice of a diverticulum, and behind the trigone were two more orifices, still smaller.

The roentgenogram of the kidney region was negative. That of the bladder region (Fig. 1) showed an oval-shaped shadow, measuring 2 by 3 centimeters, with a nipple-like projection at one end, lying well to the right of the mid-line and for this reason presumably extravesical. The calculus seen through the cystoscope cast no shadow.

Cystogram with the bladder filled with sodium iodide solution (Fig. 2), showed the above-described shadow to be entirely extravesical and contained in a diverticulum connected with the bladder, as demonstrated by a small isthmus connecting bladder shadow and calculus. Figures 1 and 2 show that the diverticulum is entirely filled by the calculus.

Pre-operative diagnosis. Of the existence of a diverticulum containing a calculus, and of an additional vesical calculus, there could be no question. Considering the patient's history of *instantaneous* recurrence of symptoms after a free interval of several months, and his description of the calculus removed being oval in shape with a projecting nipple, it was not unreasonable to assume that the two calculi had been attached, and the vesical calculus therefore suspended. To account for the residual urine, the diagnosis of contracture of the vesical orifice was arrived at by exclusion of other causes of obstruction.

Operation. Suprapubic cystostomy. Removal of vesical calculus, and excision of a diverticulum containing a second calculus. Punch operation for contracted vesical orifice.

On account of excessive scar tissue formation, it was with considerable difficulty that the peritoneum was dissected free and the bladder opened. The residual urine was very purulent and foul-smelling. An oval calculus, measuring 3 by 4 by 6 centimeters, with a projecting spicule at one end (see Fig. 3) was removed. There were two small diverticula behind the trigone, each about thimble-sized, and empty. No attempt at excision was made. The third diverticulum, about the same size, containing the above-described calculus (Figs 1, 2, and 4), was exposed by an extravesical dissection of the right posterolateral aspect of the bladder, and excised *in toto*. The opening into the bladder was closed with catgut and the site of the diverticulum drained extravesically.

The most important feature of the operation was the dense fibrous contracture of the vesical orifice, making the insertion of the tip of the little finger impossible. This condition was relieved by the use of Young's punch instrument, the procedure being very simple because it was aided by a hand in the bladder. Closure was made with prevesical drainage and a tube in the bladder.

Postoperative history. The first few days of convalescence were critical on account of hæmorrhage from the perivesical dissection and on account of a temporary suppression of urine. The suprapubic scar tissue caused delayed closure of the fistula, so that a secondary operation under local anæsthesia was finally necessary. Seen 4 months

after operation the patient was symptom-free, had no residual urine, and was passing a large, normal stream for the first time in his life.

CASES IN LITERATURE

Reports of calculi contained in diverticula are not rare. Out of Judd's (1) series of 44 diverticula, there were 4 containing calculi, and there are many other such cases in the literature. There were, however, only 2 cases to be found in which there was a dumb-bell-shaped calculus, contained partly in a diverticulum and partly in the bladder. One of these, in which the dumb-bell calculus was removed intact, was included in Judd's series, and was reported in detail by Martin (2). Here there was no history of recurrent calculus-formation. In the other case (Young, 3), calculi continued to recur after several suprapubic cystotomies and litholapaxies, and after a perineal prostatectomy, until finally, by cystoscopy, the small orifice of a diverticulum was observed. Through this orifice there projected a small spicule of stone. At operation, a calculus was removed from the bladder and another from the diverticulum, each with a projecting fractured point, the two fitting together. There was no further recurrence of calculi. In this patient's previous record there was likewise a history of complete relief for several months after operation, and then *sudden* recurrence of symptoms (frequent and painful urination), presumably on the occasion when the connecting isthmus between the two calculi gave way, and the vesical calculus was allowed to drop to the floor of the bladder. This case is analogous to the one reported above, in that in each there was successive calculus-formation upon a spicule of stone projecting into the bladder, and acting as a foreign body. The two differ in that in Young's case there was no residual urine (after prostatectomy) and yet the calculus-formation continued.

The finding of a contracted vesical orifice associated with a diverticulum is in keeping with the report of Hinman (4), who, in a series of 21 bladders with diverticula, made the surprising observation that 13 showed a contracted vesical orifice, while four more were of the fibrous ring type of prostatic hypertrophy. The co-existence of these two conditions is therefore not unusual, and the frequent association would tend to indicate more than mere coincidence. As to which is the primary etiological factor, proof is wanting.

CONCLUSIONS

The above case is of interest because of its uniqueness, and because it illustrates the futility of removing a vesical calculus without looking for an underlying cause of calculus formation. Here there were two etiological factors, a residual urine and a foreign body, either of which was adequate cause for recurrence.

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A CONSIDERATION OF THE LATENT STAGE AND OF THE PERIOD OF REINFECTION IN MASTOIDITIS DUE TO STREPTOCOCCUS MUCOSUS CAPSULATUS[1]

BY FRED WHITING, M.D., F.A.C.S., NEW YORK CITY

OF the many infecting organisms which we encounter as responsible agents in the production of inflammation of the mastoid, the streptococcus mucosus capsulatus is not only the most virulent in its destructive properties but the most insidious in its progress as well. In considering the peculiar manifestations which characterize the course of mastoid inflammations due to the pernicious activity of this agent, there are two significant features which distinguish it from the pathological processes instituted by other members of the streptococcus family.

The first of these peculiarities is characterized by a disposition of the acute inflammatory processes which usher in the attack of mastoiditis to abate and for all active symptoms temporarily to subside or disappear. This phase of the disease which we denominate "the latent stage," is encountered immediately after the early acute manifestations have reached their height and is likely to beguile both the patient and his medical adviser into a sense of fancied security from which they experience a rude awakening on the sudden reappearance of all the early acute symptoms.

These are revived in a greatly exaggerated form usually heralded by a chill and followed in orderly succession by unmistakable evidences of meningitis. The progress of the disease from this point forward is distressingly rapid and the termination almost inevitably fatal. The onset of these mucosus infections resembles that of any other otitis media, but as soon as the pain is relieved by spontaneous rupture or an incision of the membrana tympani, the case from that time on is characterized by an entire absence of symptoms; there may be complete disintegration of the mastoid structures and aside from the discharge, the patient will insist that he feels no discomfort. This condition continues throughout the entire latent stage, without pain, temperature, mastoid tenderness, or prostration, and if uninterrupted by operation meningitis finally supervenes, and the death of the patient occurs.

It is of the most vital importance that the presence of this organism be recognized as early as possible and that it may not escape detection, a careful cultivation should be made of the ear discharges of all patients where opportunity permits. The unscientific attitude of those practitioners who decry as a needless refinement of medical practice the disposition of otologists to insist upon knowing the nature of the infecting organism, and who entertain a manifest pride in the dictum that "pus is pus," is quite indefensible when we consider the high percentage of mortality which attends upon those cases of mucosus infection which are permitted to drift along with an unwarranted sense of security through the latent stage without operation, because the organism has not been recognized and the surgeon thereby placed on his guard.

The method of conducting the treatment of a case of mucosus otitis as soon as we are aware of the germ with which we have to deal differs in no respect from the treatment of other suspected mastoid inflammations save that it is very important that roentgenograms should be repeatedly made at brief intervals until all discharge has ceased and until the fundus has resumed its normal physiological appearance. In the X-ray plate we possess a diagnostic aid in determining the increment of conservative safety for the patient as well as the most favorable moment for operation, the importance of which cannot be overestimated and those of us who are fortunate enough to be able to command the services of that master of X-ray technique, Dr. George Dixon, will gladly testify to the unfailing accuracy with which his plates reveal the most craftily concealed structural changes of the mastoid bone. Given good roentgenograms

[1]Presented before the Clinical Congress of American College of Surgeons, New York City, October 21, 1919.

repeated with sufficient frequency and we can greatly reduce the dangers of the latent stage of mastoiditis due to the streptococcus mucosus capsulatus.

The second peculiarity which emphasizes the dangers of this type of mastoiditis should be denominated the "period of reinfection," which phenomenon may manifest itself at any time during the convalescence of the patient varying from a few days after operation, when granulations have only begun to cover the walls of the bone cavity, to a period when the healing is far advanced and even occurring in one case which I saw after the wound was completely healed.

The stage of reinfection, occurring as it usually does after the patient is measurably well along on the road to recovery and when his anxiety and that of his friends regarding an unfavorable termination has been allayed, is associated with particularly distressing consequences. The chill which almost uniformly announces the onset of the complication is followed immediately by severe prostration and as a rule meningitis develops rapidly and runs its course to a fatal termination in a few days uninfluenced by any measures, therapeutic or operative, which may be undertaken.

A brief summary of a case which came under my personal supervision will suffice to illustrate the insidious manner in which reinfection may develop, notwithstanding every indication that recovery is fully established.

The patient was a business man, of 35, who had always enjoyed good health and who 3 weeks before I saw him, had suffered an attack of grippe. In the course of this illness his ear became infected and he was seen by an otologist who opened the ear-drum and instituted the usual treatment for such a condition. The inflammation spread to the mastoid and he was advised to submit to operation. He declined this advice and consulted me a week later with all the classical signs of mastoiditis well developed. I advised operation to which he consented after deliberating a day or two. His roentgenogram showed extensive cavitation and the mastoid operation corroborated the X-ray plate in every detail. The dura was not exposed at operation.

He made a somewhat slow but quite uneventful convalescence, the wound healing kindly until there was only a shallow granulating pit very small in area over which a protective layer of gauze was held in place by a strip of adhesive plaster.

He had resumed his customary occupation and considered his recovery as fully established, when, while at work in his office, he suddenly experienced a chill associated with headache and prostration which compelled him to return home early one afternoon. Within a few hours he exhibited well-marked rigidity of the neck. Fluid drawn by lumbar puncture was distinctly turbid and upon subsequent examination was found to contain streptococcus mucosus. The progress of the disease was not arrested by subtemporal decompression and the patient died about 60 hours after the incidence of the chill.

While the experience just recited is distressing and most disappointing, it is, unfortunately, so common in mucosus infections as to occasion but little surprise, whereas a similar misfortune due to a different organism would be most unexpected and disconcerting.

It is evident, therefore, that the streptococcus mucosus is endowed with certain pathogenic properties not possessed by other representatives of the streptococcus family. The only demonstrable morphological difference between the mucosus and the numerous other types of streptococcus is the possession of a tough capsule to the protection of which it seems not improbable may be due at least to some extent its resistance to the germicidal action of the antiseptics which are commonly used for purposes of cleansing the mastoid wound during the process of healing.

If the writer may be permitted, he would like to offer a suggestion which he believes contains a hint of practical clinical value in the treatment of the granulating mastoid cavity during the course of healing. The suggestion is as follows: Do not, after completing the operation for mucosus mastoiditis, suture the flaps except at the upper and lower angles, thus leaving an open wound into which may be introduced gauze packing moistened with a weak solution of tincture of iodine about ½ per cent. The use of the moist iodine gauze dressing should be continued until the surface of the bone is invested with a complete layer of granulations. The importance of this expedient lies in the fact that strong solutions of iodine cause the deposit of an exudate within or beneath which those germs which have not been destroyed by coming into immediate contact with the iodine thrive and increase. The weak solution

does not cause the formation of any protective exudate and filters into all the open bone cells, within which isolated colonies of the organism are still lurking, thus being responsible for their destruction. As a further suggestion the most scrupulous care should be exercised in the introduction of the gauze packing during the healing of the wound in order that the newly formed granulations may not be lacerated, thereby exposing an absorptive surface to this virulent organism. As a feature of additional interest it is worthy of remark that diabetic patients of middle age, who are attacked by mastoiditis, in a large percentage of cases exhibit streptococcus mucosus as the infecting organism and inasmuch as the laboratory has demonstrated that this germ grows with great luxuriance in a saccharin medium, it may be possible that an exhaustive study of mastoiditis in diabetics will disclose an interesting relationship which has not hitherto been appreciated.

In concluding this paper the writer would propound the following problem for the consideration of those colleagues who will discuss it. Are we justified in the belief that mucosus inflammations of the mastoid are attended with greater danger to the life of the patient than other streptococcus infections of that structure or is such an impression merely one of the many prevalent and misleading notions which a wider experience will demonstrate is not well founded? In the judgment of the writer mastoiditis due to streptococcus mucosus must be regarded as a very dangerous malady, from the serious consequences of which the patient can feel no security until the wound is permanently healed.

SYPHILIS AND PREGNANCY

A Preliminary Note

By WILLIAM J. YOUNG, M.D., Louisville, Kentucky
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SYPHILIS is receiving greater attention today than any other disease which afflicts mankind, not because of any appreciable increase in incidence of the malady but for the reason that the medical profession, the health authorities, and the general public have been made to realize the prevalence of the disease and its menace to those infected as well as those with whom the infected associate. There are so many possible avenues of infection that only by investigating and closing those most apparent is it possible even to make a start toward limiting the ravages of the disease or lowering its present incidence.

Of the male and female the latter is least likely to have any knowledge of being infected with syphilis. In acquired lues in the male there is usually sufficient clinical evidence (past or present), i.e., primary, secondary or gummatous lesions, to warrant the taking of a Wassermann. In the female, however, where the primary lesion is situated within or about the vagina, secondary manifestations being either absent or so insignificant as to be unnoticed by the patient, she may be totally ignorant of the infection until repeated miscarriages, stillborn children, intense headaches or gummatous lesions about the body attract the attention of her medical adviser and suggest the causative factor.

In fully 40 per cent of instances women present no syphilitic history, nor have they any knowledge of their condition, and it is oftentimes difficult to make them believe or understand the nature of their affliction. The fact that both primary and secondary lesions disappear, whether the patient receives treatment or not, is the principal cause of the prevailing misunderstanding.

The most pitiable condition brought about by ignorance concerning the disease is noted in the children of syphilitic women. This ignorance has been the cause of more sorrow and distress to seemingly well parents, and the means of populating more feeble-minded

institutions and insane asylums, than any other single factor of which I have knowledge.

When the possibilities of neisserian infection were shown to the medical profession and the public, measures were adopted by which the eyes of the newborn, be it a child of the highest or the lowest class, were subjected to instillations of argentum nitrate solution to prevent the development of ophthalmia neonatorum and probable ultimate blindness. The physician who neglects this precaution is held open to criticism irrespective of who the mother may be.

It is perhaps too radical to suggest that every pregnant woman have her blood examined for the spirochætæ of syphilis, but certainly when one has in mind the amount of social damage wrought by hereditary lues, it is not asking too much that obstetricians consider such a possibility and make careful inquiries when a pregnant woman first comes under observation.

During the last few years, at the Louisville Public Hospital, the routine measure has been adopted of making a blood Wassermann when each pregnant woman is admitted. The following table shows the results.

	Cases
Wassermann examinations made	267
Found negative	200
Found positive	67
1+	6
2+	11
3+	22
4+	28

Positive about 25 per cent; of these 18.7 per cent either 3+ or 4+.

I have no accurate record of the number of such syphilitic women who presented skin manifestations, but am safe in saying the percentage was very small. As some of the patients remain in the hospital for 5 weeks before accouchement, it is possible to administer antisyphilitic treatment (arsphenamin and mercury) with the prospects of insuring the birth of an apparently healthy child receptive of antiluetic treatment. Even where a positive Wassermann is found only a few days before delivery, it gives the mother and child an opportunity to begin treatment with the hope of an ultimate clinical cure.

When the Wassermann is found positive on discharge from the obstetric ward, the patient is informed of her condition and invited to return to the syphilitic clinic for further observation and treatment. The imperative need for "follow up" work among such patients is evident, as they are more or less from the lower strata of life and correspondingly ignorant. The mother with her household duties and new interests is wholly occupied and soon forgets the vital necessity of treatment. Unless the patients are followed by an intelligent social worker and made to realize the need for treatment, the chances are they will not be seen again until referred by one of the other clinics perhaps after irreparable damage has been done.

The greatest obstacle to the eradication of syphilis is the secretiveness of those infected. While it is impossible for us to prevent "the sins of parents being visited upon their children," by routine Wassermann examination it is possible to discover many cases of unsuspected lues and institute treatment for the parents as well as the children, the latter being innocent victims.

In the obstetric wards of the numerous charity hospitals throughout the country, doubtless thousands of unsuspected cases of lues could be found if a routine Wassermann examination were made when each patient was admitted, and the children of those infected could thus be properly treated and given a chance to become useful citizens. The mere fact that women of this class are unlikely to be aware of infection and totally unable to care for syphilitic offspring, is sufficient justification for recommending routine Wassermann examination.

CONCLUSIONS

1. Routine Wassermann examination should be made in obstetric wards of charity institutions when patients are admitted.

2. It should be just as much the duty of the obstetrician to ascertain evidence or history of lues in his patient as to conduct delivery.

3. Considering the source of patients in the charity institutions the percentage of syphilis associated with pregnancy (in Louisville) is not excessive.

DEPARTMENT OF TECHNIQUE

FRACTURES OF THE PATELLA, OS CALCIS, AND OLECRANON TREATED BY FISCHER'S APPARATUS

By D. FOLDES, M.D., Cleveland, Ohio

ERNEST Fischer, of Budapest, Hungary, described an apparatus in 1910 for the conservative treatment of fractures of the patella and presented patients treated with his method at the International Medical Congress in Budapest, in 1910. The apparatus is very simple and its application easy. His method solves two important problems: (1) mobilization of the knee-joint, and (2) bony union of the fragments.

There are all kinds of methods given in textbooks for the treatment of fractures of the patella, but mention is not made in American textbooks of the method presented below.

Before describing the apparatus I will give a brief résumé of Fischer's article published in the *Gyogyaszat*, Budapest, in 1910.

There are two methods of treatment: (1) the conservative and (2) the operative treatment. Nearly all the conservative methods except those of Bardenheuer and Tilanus consist in immobilization of the knee-joint. Bardenheuer keeps the fragments together with a constant, adjustable, and exactly measured force. The disadvantage of his method is that the patient has to stay in bed. Another conservative method using mobilization is the one described by Tilanus and applied by many prominent surgeons. Twenty-four hours after the injury the knee-joint is bent passively; 14 days later the patient walks with the help of crutches. With this method bony union is not obtained but in many cases there are good functional results.

Bony union is not always procured with operative procedures especially when mobilization is employed, and yet mobilization is really the proper method to be used in every injury of the knee-joint.

Firm bony union does not mean a perfect functional result if immobilization is employed after operation. Fibrous union procured with mobilization will in most cases give a good functional result.

According to Lucas Championniere any method whatever is better than immobilization. Immobilization causes atrophy of the quadriceps muscle, atrophy of the bone, shrinking of the ligaments, and ankylosis of the joint. The patients suffer more in the treatments of such secondary results than from the direct injury.

The advantage of the operative procedure should be the mobilization of the joint, and this advantage is lost when immobilization is employed following operation. If the operative measures employed do not keep the fragments together, how can it be expected that plaster-of-Paris bandages will prevent diastasis of the fragments? Such bandages impair the tonicity of the quadriceps muscle and have no influence on the position of the fragments.

Everyone fully realizes the fact that the functional result is more important than the anatomical result, that bony union depends on the elimination of the diastasis, that good functional results depend on the early mobilization of the joint and on the prevention of atrophy of the quadriceps.

Gulliver, in 1811, proved that the diastasis of the fragments due to the contraction and later to the retraction of the quadriceps muscle is the cause of the lack of callus formation. The ligamentum patellæ proprium is quite retracted also. MacEwen, Koenig, and Hoffa found another cause for the lack of callus formation in the interposition of the lacerated periosteum between the fragments.

The diastasis of the fragments depends upon the extent of the laceration of the fibrous tissue covering of the patella and of the reserve extension apparatus, i.e., the lateral ligaments. The hæmatoma also separates the fragments.

As a conservative treatment, Fischer's method solves the problem of approximation of the fragments and at the same time the mobilization of the joint, without causing diastasis when flexing the joint. Even postoperatively it is the best method to prevent separation of the fragments when mobilization is employed. It relieves the tension on the suture by overcoming the retraction of the quadriceps muscle.

Fischer's method is indicated for treatment of fracture of the patella—

1. When the fracture is not older than 2 weeks and the reserve extension apparatus is not torn. Laceration of the soft tissues can be diagnosed either by palpation or from the extent of the diastasis. If the diastasis is not more than 3.5 centimeters then we may conclude that at least the lateral parts of the extension apparatus are intact (lateral ligamentous attachment). And finally if the patient is able to raise his leg, it is understood that the extension apparatus is practically intact. But should the patient be unable to lift his leg this does not absolutely signify that the extension apparatus is torn, because the patient may not raise his leg because of the pain.

2. When no definite indication as to conservative or operative interference is found. In such cases Fischer advises extension for 12 days. If, during this time, one fails to get good coaptation, operation is indicated. The time spent with the extension is not lost because the fragments are closer to each other and the hæmatoma is smaller.

3. When the reserve extension apparatus is torn, when the diastasis is more than 3.5 centimeters, when the fracture is more than 2 weeks old. Then operative treatment with the application of Fischer's extension apparatus postoperatively is indicated.

The apparatus consists of a steel plate 30 centimeters long, 4 centimeters wide, and 1 millimeter thick as a base, furnished with three hooks at one end and 6 hooks at its other end. The force of this spring on bending is very great and can be adjusted accurately. One, two, three, or more plates may be added to the base and they are held together with a screw. The force of the traction can be increased either by bending the steel plates or by using more plates (Fig. 1). The apparatus can be used for fractures of the patella, olecranon, and os calcis, or in any case where traction is needed to overcome the separation of fragments.

The adhesive plaster stays are prepared as traction splints—both 60 centimeters long, one for the thigh, the other for the leg. Figures 2 and 3 show these adhesive traction splints.

The adhesive traction splints and the apparatus are applied as follows: The patient sits in bed with the leg extended, and while the assistant is holding the fragments in apposition the adhesive splint (Fig. 2) is placed on the anterior surface of the thigh in such a way that the point of convergence of the strips is upon the tendon of the quadriceps muscle, the divergent strips are placed

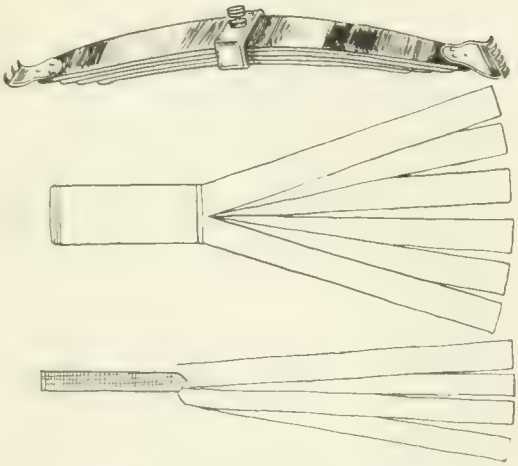

Fig. 1 (at top). Apparatus made of steel plates.
Fig. 2 (middle). Upper adhesive stay to be applied on the thigh.
Fig. 3 (below). Lower adhesive stay to be applied to the leg.

and held to the skin upon the quadriceps muscle. The longitudinal strips are reinforced with a few transverse strips and with a bandage. Adhesive splint 3 is placed on the leg in such a way that the point of convergence of the strips is upon the ligamentum patellæ proprium, and the divergent strips are placed at the inner and lateral sides of the leg. These strips are reinforced with adhesive running transversely three fourths of the circumference, so as to leave the edge of the tibia free, and a roller bandage is applied above these. On account of hæmorrhage it is advisable to apply a flannel bandage to the knee-joint for about 6 to 8 days.

After these adhesive splints are applied a hole is cut in the upper wider adhesive, and the lower adhesive splint is pulled through this opening. The ends of the adhesive strips are hooked on to the ends of the apparatus. As many steel plates are added and screwed on to the base as are needed. Figure 4 illustrates the apparatus in place. This apparatus can be substituted by a piece of hard wood 30 centimeters long, 2 centimeters wide, and 1 centimeter thick, straight or slightly bent having a pulley at each end (Fig. 5).

The adhesive splints are the same as described above except that the free end of the adhesive is cut shorter and a small piece of wood is inserted at its end and a cord tied to it. This cord is carried over the pulleys. Traction is made with rubber tubes attached to the cord with a ring (Fig. 5). The writer has modified this apparatus by replacing the rubber tubes with springs and

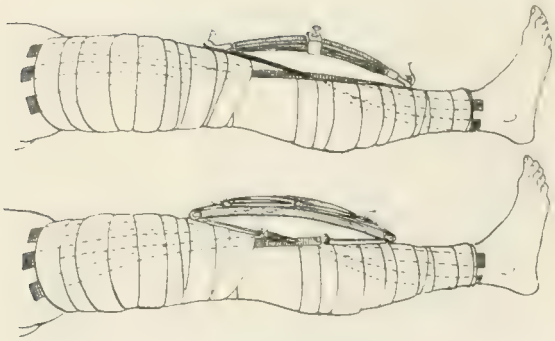

Fig. 4 (above). Steel apparatus in place.
Fig. 5. Wood and rubber tube apparatus of Fischer in place.

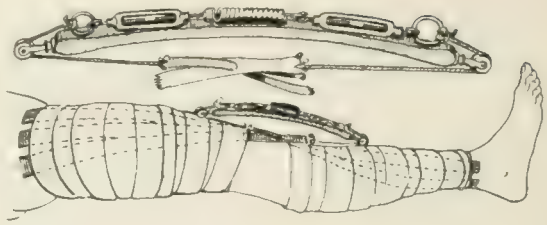

Fig. 6a (above). Same apparatus as in Figure 5, modified.
Fig. 6b. Same as Figure 5 modified. Rubber tube replaced by spring and turnbuckles.

turnbuckles (Fig. 6). This makes the application of the apparatus and the adjustments much easier. The traction is constant and can be accurately adjusted, by means of the turnbuckle. The springs and turnbuckles can be bought in any hardware store.

Important rules to follow are that: (1) the apparatus should be applied as soon as possible after the injury. (2) Full traction should be applied at once and not progressively and if 2 days later the X-ray still shows a diastasis then the traction has to be adjusted accordingly. (3) If the pressure on the skin of the patella caused by the adhesive is too much this should be corrected by suspending the apparatus above the bed, if the patient is lying in bed, or by placing cotton under the two ends of the apparatus to lift the adhesive from the skin if treated by ambulatory means. (4) After a few days when the danger of hæmorrhage is passed the patient may get out of bed and walk. The joint is bent passively many times daily, slowly and progressively.

The dressing has to be changed in 2 to 3 weeks. After 8 weeks the dressing is completely removed and active motion of the knee progressively begun.

As a conservative treatment this procedure is judiciously planned and gives good results, as the fragments are approximated with a constant and accurately adjustable force. With Fischer's apparatus the patient may dress, get out of bed and walk. Following its use the knee-joint will not be stiff, as it is moved passively from the first day on without the fear of producing a diastasis between the fragments. It prevents the eversion of the fragments by pressing on their anterior surfaces.

After operation the apparatus overcomes contraction and retraction of the quadriceps; relieves the tension of the suture material and prevents it from tearing; permits the patient to be out of bed, to dress and to walk; and permits examining the wound and changing the dressing if necessary.

The writer has applied the apparatus in a case in which the patella was fractured into several fragments, the lower one very small. The diastasis and swelling of the knee were considerable. As soon as the apparatus was applied the patient was able to lift his leg easily without pain or discomfort. The next day the patient was taken to the hospital where X-ray plates taken by Doctors Hill and Thomas showed the following:

On March 13, 1918, we examined the region of Mr. A. D's left knee on which an ambulatory splint had been applied. The plates showed a comminuted fracture of the patella with marked displacement of the fragments. The distal fragment was much smaller than the proximal one, and in addition to being displaced downward was rotated so that the fractured surface was anterior and the anterior surface was external. There was one small fragment within the gap between the two main fragments. After readjustment of the splint, plates were again taken which showed considerable improvement in the apposition of the fragments, but the rotation of the distal fragment was not perceptibly changed. After operation plates were taken which showed a very marked improvement in the position of the fragments, the small intervening fragment having been removed and the displacement and rotation of the distal fragment nearly overcome.

An operation was done 12 days after the injury because it was impossible to bring the fragments into good apposition. Local anæsthesia was used with a 0.5 per cent novocaine-suprarenin solution circuminjecting the operative territory subcutaneously and subfascially and injecting 20 cubic centimeters of the solution directly into the joint. Then the knee was bent and extended to distribute the solution throughout the joint and between the fragments. The anæsthesia was very good. The patella fragments were exposed by a semicircular incision. The fragments were brought together by an encircling chromic catgut suture, the torn capsule and ligaments sutured, the wound closed, and the apparatus applied. The patient left the hospital 4 days after operation and was treated at his home and later in my office. The treatment consisted in dressing the wound and passively bending the knee-joint daily. The apparatus was removed 6 weeks after operation at which date the patient was able to flex his knee to a

considerable degree and there was no difficulty in reaching a perfect result within a few weeks and without complaints.

The derangement of the knee-joint, the torn ligaments, and the interposition of soft tissues made the operation necessary, but the time which elapsed before the operation was not lost. The extent of damage found justifies the statement that the operation without mobilization would have caused a stiff joint, or at least considerable difficulty and pain would have accompanied the mobilization for several weeks. The patient was restored to work more quickly than would have been the case with immobilization.

Fractures of the olecranon receive very little attention in the textbooks, though this form of fracture is not so rare and, from the standpoint of future functional result, it is important that it should heal well.

Diffenbach advised tenotomy of the triceps tendon. Lister was the first to use antiseptics in performing primary suture of the fractured olecranon. Most of the textbooks advise operation; some of them advise conservative treatment such as the application of plaster-of-Paris bandages and splints. Hoffa applies adhesive strips on the posterior surface and splint or plaster-of-Paris bandage above this, the elbow being in extension; 6 weeks later when the dressing is taken off the elbow is bent passively. Bockenheimer punctures the hæmatoma, approximates the fragments by pressing on them with the finger, and applies an adhesive strip on the posterior surface of the elbow. On top of this, wooden splints are placed with the elbow in extension. In case of operation Bockenheimer advises, as a postoperative measure, traction with the patient in bed and the elbow bent at a right angle. The portable extension dressing of Bardenheuer is too complicated and less successful.

According to Lucas Championniere the immobilization methods are very bad. He claims that suturing is not necessary, that the contraction of the triceps is the cause of the diastasis which could not be overcome with any apparatus familiar to him. Championniere's results with massage and mobilization treatment are good.

Fischer's apparatus is very effective in the treatment of fractures of the olecranon inasmuch as a constant and accurately adjustable force pulls downward the olecranon dislocated upward, leaving the elbow free and permitting the passive flexion of the elbow without producing a diastasis between the fragments. The use of this apparatus as a postoperative measure is more sensible than the splints which immobilize the joint. The

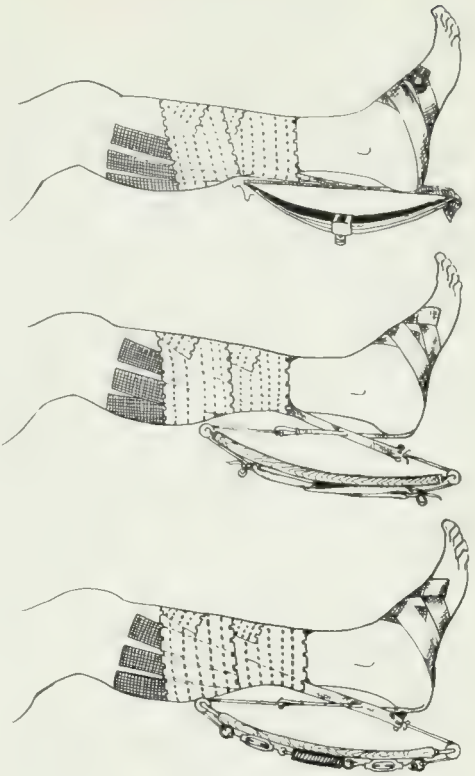

Fig. 7, a, b, c. Apparatus applied for fracture of os calcis.

apparatus relieves the tension of the suture and soon permits the passive flexion of the joint. The application of the dressing is similar to that for fractures of the patella.

I applied the same apparatus at the request of Dr. W. Stern, Mt. Sinai Hospital, Cleveland, in a case of fracture of the olecranon. The patient was a child, 18 months old. The wooden splint and the adhesive stays were smaller than those mentioned in the description being made to correspond to the size of the child's arm. The only difficulty in the application was caused by the swelling of the elbow. The result was very good. The X-ray plates taken by E. Freedman showed good apposition of the fragments.

Another fracture which is similar to fractures of the olecranon and which belongs to the typical fractures although it is more rare, is fracture of the os calcis produced by the sudden and powerful contraction of the gastrocnemius and soleus muscles. Several kinds of dressings are advised for the treatment of fractures of the os calcis, but these dressings act only on the distal fragment and have no influence on the proximal fragment which is

dislocated upward. The most popular treatment of such fractures is the conservative treatment which has the same effect as above. The foot placed in very strong plantar flexion, is held in a plaster-of-Paris bandage or in an apparatus made from a plaster-of-Paris model. The result of this treatment is atrophy of the muscles and a stiff ankle-joint.

The Bardenheuer dressing is the only one which approximates both fragments. The difficulty with this dressing, however, is that the adhesive strips producing the longitudinal extension are applied on the two sides and not on the posterior part of the leg; therefore they do not have sufficient pull on the muscles of the calf, also the patient must remain in bed for 6 weeks.

Fischer's apparatus for this kind of fracture is effective and simple. Figure 7 illustrates its application. This dressing approximates the fragments with great force, with a constant downward traction on the proximal fragment and upward traction on the distal fragment. The patient is not confined to bed and may walk with the help of a cane if the heel of the foot is raised. Early motion of the ankle-joint is permitted.

The same apparatus may be used in every fracture where traction is needed to overcome separation of fragments.

INDICATIONS FOR CHOLECYSTECTOMY AND A METHOD OF PERFORMING IT

By J. L. YATES, M.D., F.A.C.S., Milwaukee, Wisconsin

CHOLECYSTECTOMY is indicated when morbid changes in a gall-bladder or cystic duct have reached a stage from which recovery can be so imperfect that recurrent attacks of cholecystitis, subsequent development of gall-stones, untoward influences upon digestive functions, or malignant degeneration are probable or possible.

Cholecystostomy may be unavoidable as an urgency measure in the presence of any of the above conditions, in patients enfeebled by age or disease. This is particularly true in empyema of the gall-bladder with extensive adhesions, in the unusual types of chronic biliary obstruction when the hepatic epithelium, having lost its power to make bile, is secreting clear fluid—the so-called white bile—and in acute cholangitis. Under these conditions the release of pressure through free biliary drainage is an immediate necessity. Under these conditions also there is likely to be associated myocardial degeneration and such patients are particularly intolerant of prolonged drainage and of the absence of bile from the intestines.

After pressure is released by free drainage, patients of the types described enjoy a period of considerable improvement. The benefits will be more certain and more pronounced if a portion of the bile obtained in drainage bottles is diluted with water and returned by proctoclysis. After a week or two, particularly if free drainage persists, there is apt to begin a decline which may lead ultimately to death. The onset of this period is so gradual there is difficulty in recognizing it promptly. There is a decreased sense of well-being and an increase in the pulse rate. Possibly a safe index is the nature of the wound repair; the healing processes abruptly become retarded. Just at this time cholecystectomy may be life-saving and by the same token may be the strong argument for cholecystostomy with choledochotomy as against choledochostomy when conditions are suitable.

Whatever be the indications for cholecystectomy, whether it be done primarily or as a second stage after cholecystostomy, it is satisfactory as it increases the ratio and the rate of immediate recoveries and assures permanence of relief. These factors are largely determined by the completeness of restoration of function in the belly wall and the reduction of intraperitoneal irritation.

A method of performing cholecystectomy has been found to meet these requirements which is easy in suitable cases and has permitted a reduction in the period of disability that places these operations in the category of an interval appendectomy.

Incision is made over the middle of the right rectus from the costal margin downward far enough to make appendectomy possible. The anterior rectus sheath is divided in the same line. The mesial leaf of the rectus fascia is separated from the anterior surface of the muscle, the

Fig. 1. Anterior sheath of rectus fascia incised, mesial portion reflected to expose rectus muscle.

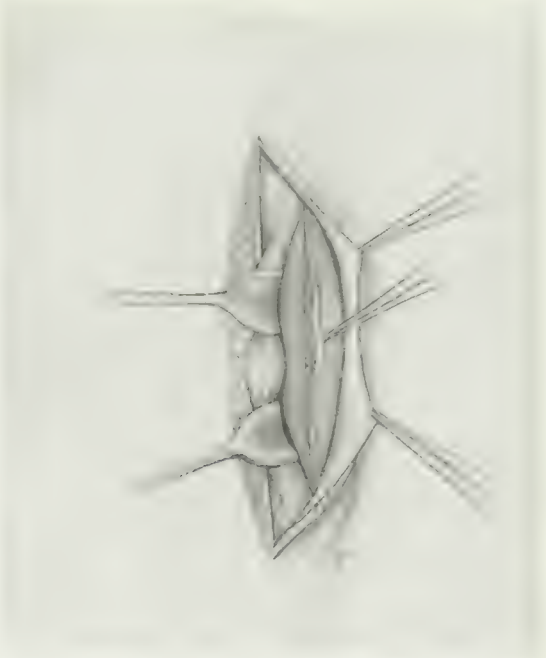

Fig. 2. Rectus muscle retracted laterally, incision made through posterior sheath and peritoneum.

muscular attachments to the midline are broken and the entire muscle retracted laterally (Figs. 1 and 2). The posterior sheath and peritoneum are divided along the line of the original incision. Moist towels are clamped to the peritoneal margins to protect all of the extraperitoneal tissues.

After the intra-abdominal examination has been completed and the appendix removed, the gall-bladder is grasped at the tip of the fundus with a broad clamp and the liver dislocated as favorably as possible.

An incision down to the submucosa is made about the fundus and continued downward along the anterior surface of the gall-bladder to the cystic duct (Fig. 3). A submucous separation of the gall-bladder and cystic duct from the serosa and subserosa is made, largely by blunt dissection. A few branches of the cystic artery require ligation. An excellent blood supply to the serous and subserous coats is assured. The cystic duct, close to the common duct, is ligated using the middle of a long strand of catgut. The duct is clamped distal to the ligature, divided and the gall-bladder removed (Fig. 4).

Removal of the gall-bladder from within outward is possibly more satisfactory than removal from without inward as the cystic duct can be clamped before any considerable pressure has been exerted upon the gall-bladder. Conditions

Fig. 3. Incisions down to submucosa of gall-bladder and cystic duct. Submucous dissection begun.

Fig. 4. Submucous dissection nearly complete. Cystic duct ligated, clamped and divided. Serosa and subserosa are not usually divided so far down along the cystic duct as indicated in the drawing, illustrating removal from below upward.

Fig. 5. Submucous dissection completed. Gall-bladder dislocated. Cystic duct ligated, clamped, and ready to be divided. Illustrating removal from above downward when exposure is limited. Usually it is unnecessary to incise the serous and muscular coats as far down as shown for sake of clearness in the drawing.

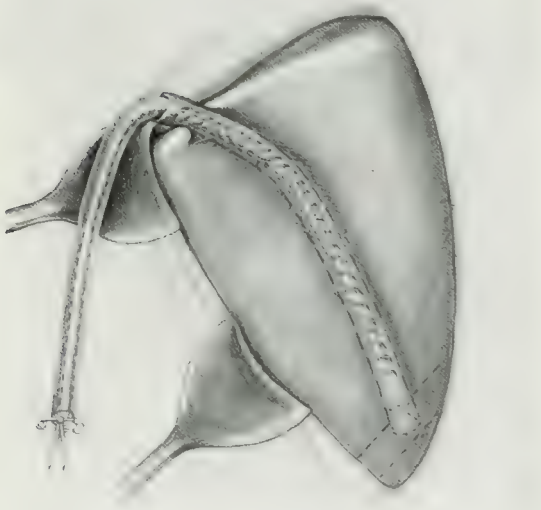

Fig. 6. Drainage tube in position, the inner end pushed over the stump of cystic duct. Serosa and subserosa of gall-bladder closed about the tube excluding injured tissue from abdominal cavity.

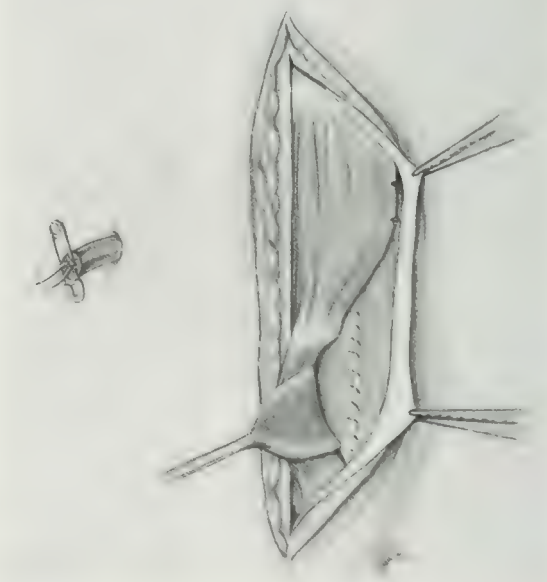

Fig. 7. Peritoneal incision closed, mesial margin of rectus muscle partly sutured in its original position. Drainage tube brought out through lateral incision.

Fig. 8. Method of closure of anterior sheath of rectus muscle with buried silk sutures.

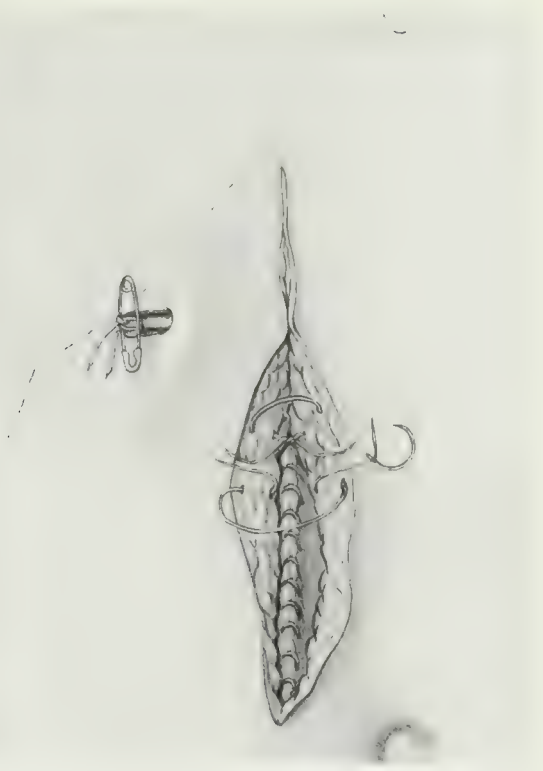

Fig. 9. Rectus fascia approximated by buried silk sutures and accurately closed with continuous catgut. Fine silk stitches being inserted to reunite deep layer of superficial fascia and so as to leave knots toward the deep fascia.

do not always permit of an adequate exposure for this method. Then removal from without inward can be done (Fig. 5). The ends of the ligature are then passed through a small drainage tube which is pushed down *over* the cystic duct stump. A knot properly placed and a safety pin hold the tube in this position (Fig. 6).

The remaining wall of the duct and gall-bladder are sutured so as to make a well-fitting covering for the drainage tube which is usually sufficient even if the gall-bladder has been contracted upon stones, to reach to the parietal peritoneum and to which it may be sutured advantageously. The tube is brought out through a small lateral stab and as there has been no liver damage and no soiling, no other drainage is needed. No attention need be given to placing omentum about the drain; the only deep adhesions will be those due to the irritation of the packing gauze used during operation and those occurring along the lines of peritoneal suture, both of which are transient if peristalsis be stimulated as promptly as possible after operation.

Closure of the peritoneum should turn outward enough of a welt to extraperitonealize the margins bruised by the towel clamps. Rectus muscle is tacked back to the midline with a few stitches including the tendinous intersections (Fig 7). Proper suturing of the anterior sheath of the rectus fascia is most important. Interrupted stitches of fairly heavy silk are so inserted that none of the suture material appears on the external surface, and when they are tied the incised margins are both approximated and everted (Fig. 8). These are then whipped over with continuous catgut. This method of closure gives more than the re-inforcement provided by silkworm-gut and the sutures do not have to be removed in 7 to 10 days when support is most needed. The permanent sutures cause no discomfort, and though the superficial wound breaks down do not act as a foreign body; in fact, wounds so closed break down less frequently than when silkworm-gut is used.

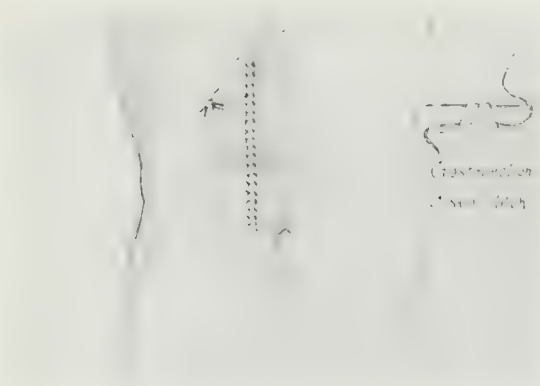

Fig. 10. Completed closure. Stitches to be removed the second day.

The deep layer of the superficial fascia is carefully approximated with fine silk stitches so placed that the knots are toward the deep fascia. There is better healing if this precaution is observed (Fig. 9). The skin is closed with interrupted stitches (Fig. 10) to permit an easier egress of serum which is further favored by a dressing of gauze soaked in warm glycerine. If the superficial loop of the skin stitch be made to include the skin margins as devised by Dr. R. E. Morter and illustrated in the diagram in Figure 10, the tendency of one margin to become inverted is prevented. The more exact approximation and better healing obtained by this stitch amply repays the few minutes added time required for its insertion.

This method of closure permits the removal of skin stitches after 1 or 2 days, which in turn promotes better healing and leaves no stitch scar. It is merely an adaptation of Cushing's scalp suture.

Even obese individuals may be allowed to sit up as soon as they desire and to be out of bed in a few days. If the rubber tube be shortened daily after the first dressing, the parietal sinus will not be troublesome.

ARTHROPLASTIC OPERATIONS WITH REPORT OF CASES OF ARTHROPLASTY OF THE TEMPOROMAXILLARY JOINT, ALSO OF THE ELBOW-JOINT[1]

By A. A. KERR, M.D., Salt Lake City, Utah
Surgeon Holy Cross Hospital

ARTHROPLASTY or making a movable out of an ankylosed joint is one of the triumphs of modern surgery. The operation consists in separating the ankylosed ends of the bones in the joint by means of a saw and chisel and interposing between the divided ends of the bone and joint a layer of fascia or soft tissue. The cut end of the bone should be sawed or chiseled off to correspond to the contour of the joint. Bony prominences and scar tissue should be removed, tension on the end of the bone should be relieved; all parts of the synovial membrane involved in the process of articulation, which is covered by adhesions and has lost its synovial character, should be covered with the transplanted tissue. One of the most satisfactory methods (advocated and described by the late J. B. Murphy) consists in cutting out a pedunculated flap of fascia and fat near the joint and swinging it between the bones to cover the rough bone surfaces. This flap is sutured in place with fine plain catgut sutures, to the capsule of the joint. Some fatty tissue is desirable in this flap. Muscle and fat may be used if fascia is not available. After about 10 days, passive motion may be begun, the patient being advised and encouraged to use the joint.

An arthroplastic operation, if aseptically done on a joint not infected, may be expected to give a good result. A new synovial membrane is formed and a fluid resembling synovial fluid is secreted. A fibrous layer becomes attached to the end of the bone.

Ankylosis may be fibrous, bony, cartilaginous, ligamentous, capsular, or extra-articular due to contractions of soft parts such as tendons, muscles, and fascia. W. S. Henderson and G. B. New classify their cases into: (1) the articular type in which the joint alone is involved; (2) the extra-articular type; (3) the articular-extra-articular type in which the etiology of the ankylosis is both within and without the joint.

Etiology. Infection, either by continuity or through the blood, and traumatism are the usual

[1] Read before the Western Surgical Association, Kansas City, December 5-6, 1919.

causes. In my cases there was a history of infection. On account of the lapse of time it is usually difficult to secure a very clear history as to the etiological factor. Blair gives trauma as a frequent cause (50 per cent) of ankylosis of the mandible.

Pathology. Lack of development of the mandible takes place if ankylosis of the jaw occurs before the fifteenth year, the teeth, owing to disuse may be poorly developed, and where scars exist due to infection they prevent the natural mobility of the muscles.

Diagnosis. Bony ankylosis allows practically no mobility, while with the fibrous variety there may be a slight motion of the joint. Roentgenograms assist some in the diagnosis, but they must be studied in connection with the clinical history and the physical findings.

Treatment. In arthroplasty of the temporomaxillary joint, a curved L-shaped incision, beginning about 2 inches above and 0.5 inch in front of the ear and down to a point about opposite the external auditory meatus, then anteriorly for about 1.5 inches, is made.

Care must be taken to avoid the facial nerve, the internal maxillary, and superficial branches of the temporal arteries. The condyle of the mandible may be sawed off with a chain saw or removed with a chisel gouge, care being taken not to injure the internal maxillary artery. If the coronoid process is involved, a sufficient amount of it should be resected to permit free motility. A flap of temporal fascia is inserted, and the wound closed with catgut and horsehair or fine silk to avoid an extensive scar.

Fig. 1. Incision for arthroplasty of the right temporomaxillary joint.

Henderson and New advise against the use of any fascia, fat, membrane or any foreign material between the ends of the mandible and the temporal bone.

The patient should be encouraged to use the jaw as soon as practicable after the operation, but too powerful attempts at opening the jaw must be avoided, as in some of these cases the teeth are easily broken or displaced. Some of the

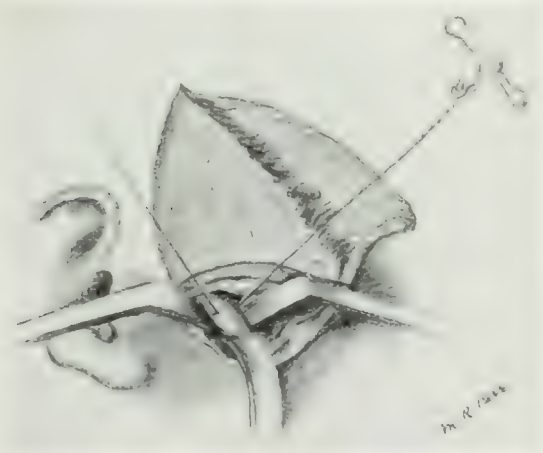

Fig. 2. Joint exposed and method of removing bone in arthroplasty of the temporomaxillary joint shown.

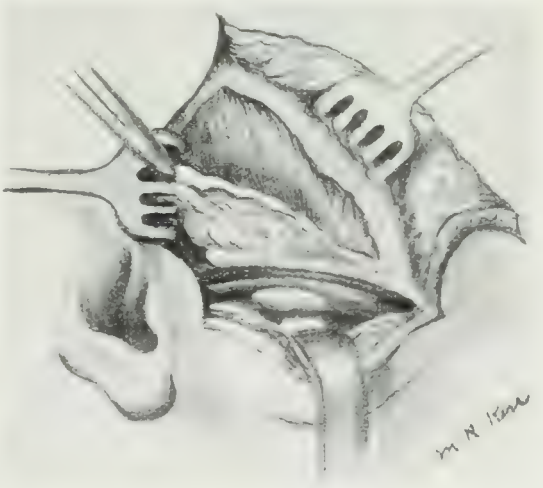

Fig. 3. Method of incising flap of fascia over temporal muscle for inserting over sawed surface of bone.

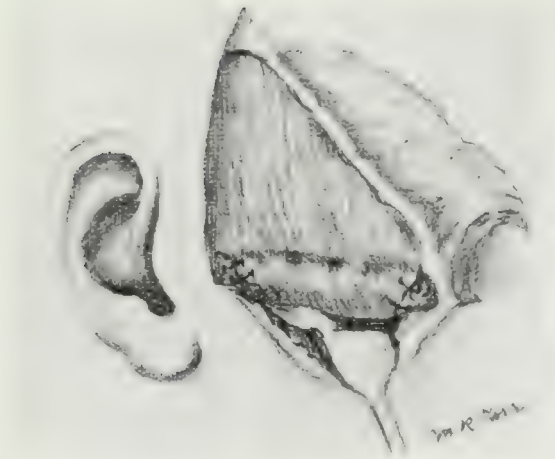

Fig. 4. Flap of fascia inserted in joint and sutured with fine catgut ligatures.

important points to be remembered in arthroplasty of the temporomaxillary joints are: (1) avoidance of injury to the facial nerve, the temporal artery, and the internal maxillary artery; (2) removal of enough bone to give free motion (about one-half inch space between the bones); (3) persistent passive motion as soon as practicable after the operation.

HISTORY OF CASES

Case 1. Mr. X, age 21. Family history negative. In 1910 the patient suffered from what he described as inflammatory rheumatism, involving nearly all the joints of his body, and for about 8 months he was unable to work on account of the pain and weakness. He developed an endocarditis. The inflammation localized in the maxillary joints and for 9 months he has been unable to open his mouth more than one-sixteenth of an inch. There is a distinct aortic regurgitant murmur over the precordia.

There is present a fibrous and bony ankylosis of both joints of the mandible with contraction of the peri-articular muscles and fascia. Roentgenograms were taken by C. W. Stewart. Arthroplasty of both temporomaxillary joints was done, using the technique previously described. Result: The patient was able to masticate solid food after leaving the hospital, but had to guard against subsequent contractions of the muscles of the mandible.

Case 2. Girl, age 16. Family history, negative. The patient has had good health up to 2 years ago, when she hurt the side of her face. Following the injury she had an abscess of the right side of her face, near the parotid gland. Her family physician attempted on four different occasions forcibly to open the mouth.

The patient could not open her mouth, except for a distance of one-fourth inch at the widest place. The lower jaw was only partially developed. Otherwise she appeared fairly well nourished. She has a webbed condition of the fingers, which involves both hands. Diagnosis: Bony ankylosis of the right temporomaxillary joint.

Under warm ether given by Dr. Wilson, the author assisted by C. A. Nyvall, did an arthroplasty of the right temporomaxillary joint, using the technique as previously described, a flap being taken from the fascia of the temporal muscle. Result: Patient is able to open her mouth normally and to masticate her food naturally, and is very happy and grateful.

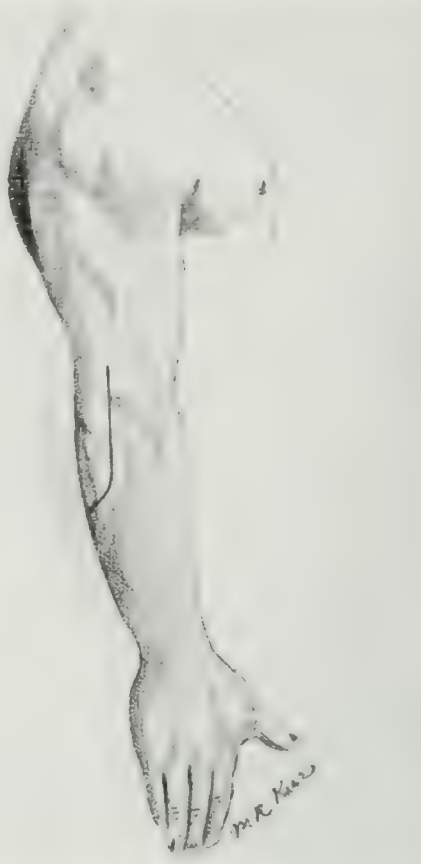

Fig. 5. Location of incision in arthroplasty of the right elbow-joint.

Case 3. A young man had a complete ankylosis of the right elbow, due to arthritis. At operation an angular incision was made beginning at the external supracondyloid ridge 1.5 to 2 inches above the line of the joint extending downward to the head of the radius and from there along the outer border of the anconeus to the posterior border of the ulna, about 3 inches below the tip of the oleocranon, then curving inward. The first part of the incision extended down to the outer border and external condyle of the humerus, between the supinator longus and radial extensors anteriorly and to the edge of the triceps posteriorly. Below the external condyle it passed down to the bone between the extensor carpi ulnaris and the outer border of the anconeus and divided the strong capsule over the head of the radius, together with the annular ligament at its attachment to the ulna. The lower end of the incision divided the lower end of the anconeus subperiosteally. The incision (Kocher's) fell accurately along the interval between the muscles supplied by branches of the musculospiral nerve and those supplied by the posterior interos-

seous, thus preventing subsequent muscular atrophy. The outer head of the triceps, together with the periosteum and the upper attachment of the capsule was detached from the humerus and the anconeus from the back of the ulna, the attachment of the triceps from the tip of the oleocranon and the flap displaced to the inner side. The external lateral ligament, with the attachment of the extensor tendons and the capsule attached to the external condyle, were separated subcortically and retracted. This enabled one to dislocate the forearm inward. The internal lateral ligament was separated subperiosteally along with the muscles from the inner border of the ulna and the internal condyle of the humerus. The ends of the bone and the diseased tissue were removed, preserving as far as possible the contour of the joint. Some peri-articular fascia was inserted. The wound was then closed.

The result following this technique gave a useful movable joint with no atrophy of the muscles.

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CATHETER RETAINER

By B. H. CAPLES, M.D., NEW YORK CITY
Captain M. C., U.S.A., Chief, Genito-Urinary Department U. S. A. General Hospital No. 41, Fox Hills, S. I., N. Y.

THE usual methods of securing an indwelling catheter such as tying it in place by means of threads tied to strips of adhesive, to a spica bandage or to the suprapubic hair have proved, in my hands, to be troublesome in application and unsatisfactory in that the proper adjustment is difficult to maintain. Probably the method most in use at the present time is that of binding the catheter with adhesive strips that run parallel with the shaft of the penis which in turn are held in place by a strip of adhesive surrounding the penis. The objections to this method are that the portion of the plaster surrounding the catheter becomes wet with urine or pus, loses its grip and fails to hold the catheter in place and the fact that this type of retention apparatus is not elastic. These objections are in a measure overcome by the rubber basket-like retainer, made in France, that buckles around the penis. This, too, is unsatisfactory in that the strap surrounding the penis is narrow and produces too great constriction if drawn tightly enough to keep the retainer in proper position. Besides it is difficult to obtain and comparatively expensive.

With these difficulties in mind I have devised a retainer that I have found to be most satisfactory. It consists of two rubber bands one-quarter of an inch in width and seven inches in length. These are crossed in the middle at right angles. A disc of thin rubber one-half inch in diameter is placed on each side and the bands vulcanized at this point. A hole, No. 10 French, is punched in the center (Fig. 1). Through this hole a pair of thumb or small artery forceps is passed about one-half inch, opened gently and the catheter (lubricated) grasped by the tip and drawn through to a point corresponding to the meatus (Fig. 2). The catheter and retainer are then sterilized.

After passing the catheter (Fig. 3) the retainer may be readjusted if necessary. The foreskin, having been carefully dried, is retracted and one turn of a strip of adhesive plaster, one inch wide and twelve inches long, is placed just proximal

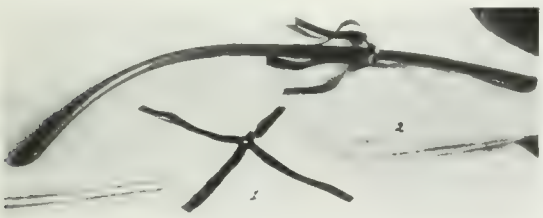

Fig. 1, inset, and Fig. 2.

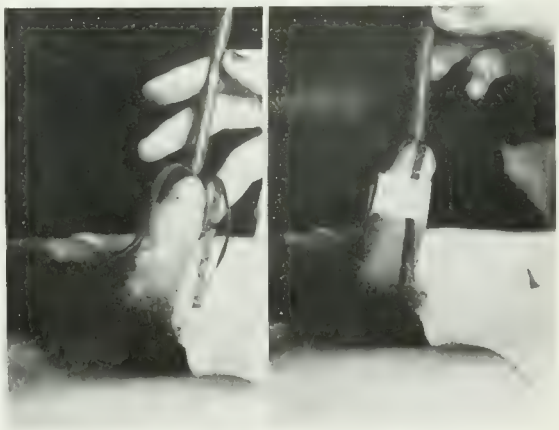

Fig. 3. Fig. 4.

to the sulcus. The arms of the retainer are now drawn up one at a time, with gentle tension, parallel to the shaft of the penis and secured in place by a second turn of the adhesive. They are now turned downward and again secured by a third turn of the adhesive which should be firmly but not too tightly applied. The retainer may be used without retracting the foreskin but this as a rule is less satisfactory.

The glans should be sponged several times daily if there be any urethral discharge and if this be marked, as sometimes occurs from the mechanical irritation of the catheter, the catheter should be removed every forty-eight hours and the urethra irrigated. If possible, a period of rest of at least several hours should intervene before it is reinserted. If the adhesive is removed with care and the retainer cleaned with gasoline it may be sterilized with the catheter and used a number of times in succession.

Although an opening of No. 10 French will accommodate the average catheter, the retainers are being made with openings of several sizes. The catheter should be firmly grasped by the retainer but not so tightly that the lumen is more than slightly occluded. If properly adjusted the catheter will not slip and owing to the elasticity of its arms the retainer tends to adjust itself to varying conditions.

In the female this same type of retainer may be used in conjunction with a T bandage, a small hole, through which the catheter passes, being cut in the bandage and the arms being secured to the bandage by safety pins or sewing.

A disc of rubber, about 5 centimeters in diameter, cut from automobile inner tubing and with a hole punched in the center through which the catheter passes, also makes a satisfactory retainer. It may be secured to the T bandage in like fashion.

A CLINICAL STUDY OF OPEN REDUCTION OPERATIONS OF FRACTURES OF THE LONG BONES WITH TWO NEW BONE CLAMPS

By J. SHERMAN WIGHT, M.D., Brooklyn

THE development of the open reduction operation of recent fractures started soon after the discovery of the X-ray. The patient could then obtain a picture of the repaired bone. He often expressed his dissatisfaction with the result. The closed method could no longer hide failure and it became embarrassing to the surgeon to find the fragments out of line or ununited.

Experienced men were able to get surprisingly accurate knowledge of the relation of the broken

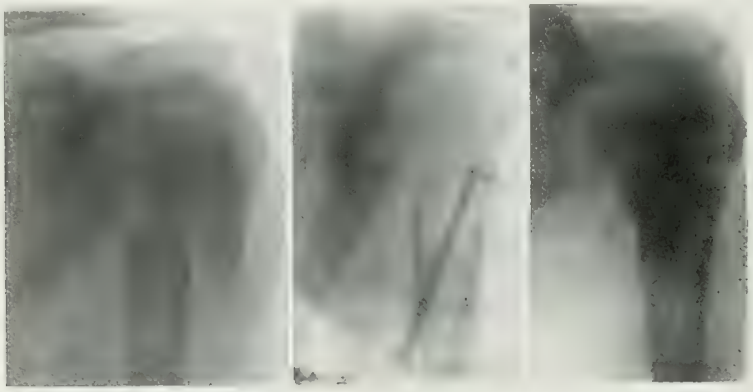

Fig. 1. Fig. 2. Fig. 3.

Fig. 1. Fracture of the surgical neck of the femur.
Fig. 2. Long screw in place securing fragments of bone.
Fig. 3. Result 4 weeks after operation.

Fig. 4.

Fig. 5.

Fig. 4. Oblique fracture of the femur.
Fig. 5. Author's bone clamp.

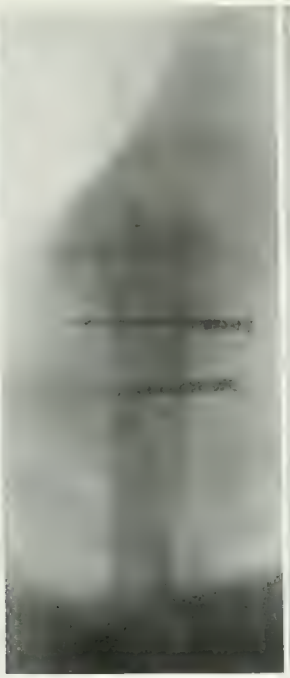

Fig. 6.

Fig. 7.

Fig. 6. Same case as in Figure 4, showing screws in place.
Fig. 7. Result of operation, same case as Figure 4.

Figs. 8, 9, and 10. Transverse fracture of the femur, showing method of tying sutures, and result.

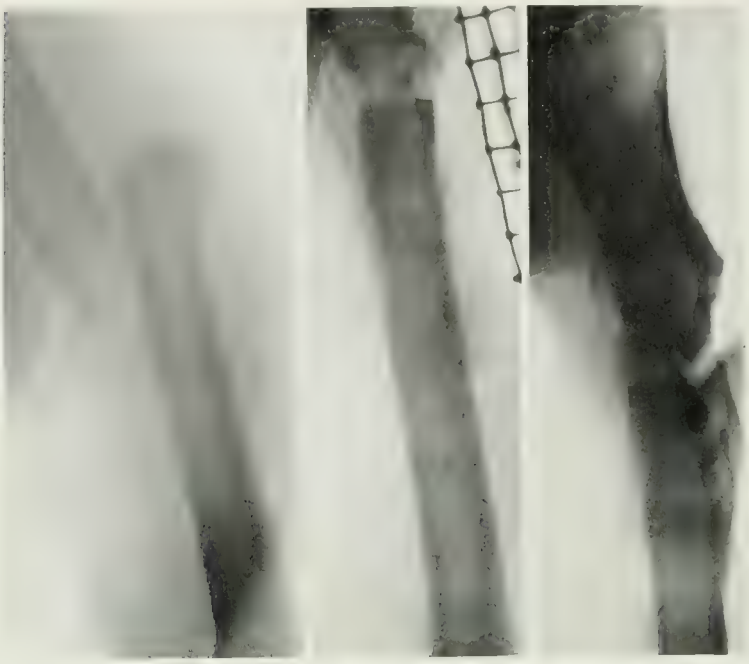

Fig. 11. Fig. 12. Fig. 13.

Fig. 11. Compound fracture of the humerus with osteomyelitis.
Fig. 12. Wound closed after drainage and disinfection.
Fig. 13. Firm union of fracture shown in Figure 11.

Fig. 14. Fig. 15. Fig. 16.

Fig. 14. Old fracture of the tibia with fibrocystic disease of bone and non-union following osteomyelitis.

Fig. 15. Graft secured with bone pegs.
Fig. 16. Result.

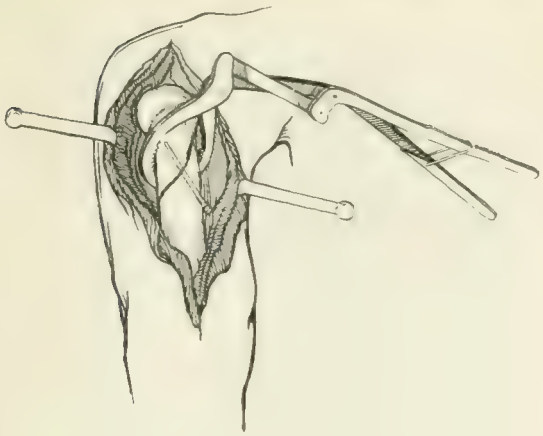

Fig. 17. Author's angular bone clamp.

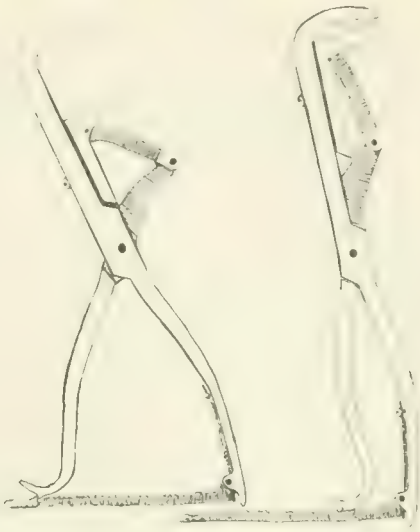

Fig. 18. Author's bone clamp.

fragments by the older methods of examination. The more accurate knowledge obtained at the present time by the X-ray relates to displacements, but the same difficulty of replacing and retaining the bone in proper alignment by the closed method remains. Many surgeons rely entirely on the X-ray for diagnosis and to verify position.

There are two kinds of lesions caused by a fracture; one of structure and the other of function. The failure of reduction may make the functional lesion permanent. Function can be restored in the presence of deformity. Pressure from splints, tight bandages, and injury to vessels and nerves at operation may cause a loss of function even if the structural result is perfect.

It is the first duty of the surgeon to restore function. This is determined largely by his ability to replace fragments and the care he uses to avoid pressure or injury to important structures. The X-ray has shown frequent failures and operators have demonstrated the impossibility of reducing many fractures by the closed method, so it may be said that a recent fracture of a long bone suggests an operation.

No operation should be performed until operability is carefully determined. Operability is concerned with the extent of bone injury, reaction from local damage, presence of acute or chronic disease, presence of bone disease, presence of recent infection or old foci of infection, and the ability to repair bone. Small detached fragments separate and cause sinuses by necrosis. Bone cavities cause chronic sinuses. Cancer may be present in bone and cause spontaneous fracture. Syphilis and tuberculous disease of bone contra-indicate immediate operation.

All cases that resist correction of conditions that cause a low operability must be treated by closed reduction. Those cases that pass the operability test require great care in exposing the broken ends of the bone. Certain well-recognized lines of approach should be followed in making incisions. They are made where the bone is most superficial and so as to avoid injury to vessels and nerves or unnecessary destruction of tissue. Table I gives the best lines of approach to the long bones.

TABLE I

Humerus	Upper end — Incision along the anterior margin of the deltoid.
	Upper third — Incision between the pectoralis major and the deltoid.
	Middle third — Incision along the outer edge of the biceps continuing upward between it and the deltoid. The brachialis muscle lies on the bone mesially to the deltoid insertion.
	Lower third — Incision splitting the triceps posteriorly and deep dissection. Ulnar nerve is back of internal condyle.
	Lower end — Incisions vertically from condyles upward; the soft parts are separated from anterior and posterior aspects of the bone through these incisions.
Radius	Head of radius — Incision vertically splitting aponeurosis of origin of extensor digitorum communis from behind at the external epicondyle.
	Neck of radius — Incision dividing and retracting the supinator.
	Upper third — Incision superficially to lateral side of extensor digitorum communis — deeply between extensor longus pollicis and extensor carpi radialis brevis extended upward from middle third. The muscles on the back of the arm are retracted mesially.
	Middle third — Same as upper third incision.
	Lower third — Incision between brachioradialis and extensor carpi radialis longus.
	Lower end — Incision between insertion of brachioradialis and radial artery.
Ulna	Subcutaneous from end to end — inner posterior aspect.
Femur	Hip-joint and neck—Incision from anterior superior spine of the ilium to the great trochanter then backward in the direction of the ischial tuberosity. Incisions either anteriorly or posteriorly to the sartorious muscle carried vertically.
	Upper shaft — Vertical incisions anteriorly or posteriorly to the sartorious muscle carried downward.

TABLE II

Bones Injured		No. of Operations	Average Age	Male	Female	Recent Injury	Old Injury	Compound Fracture Comminuted	Bone Disease	Syphilis and other Diseases	Acidosis Corrected with NaOH	Suture	Screw	Bone Peg	Inlay Bone Graft	Lane Plate	Average time of removal of Screw weeks	Average time of Union in Recent Injury weeks	Average time of Union in old Injury weeks	Bony Union	Fibrous Union	Non-Union	Deformity	Limp	Bone Infection	Wound Infection	Emboli	% Mortality
Humerus	Upper Extremity	82	17	41	11	47	5	0	0	0	27	0	81	1	0	0	3	4	5	52	0	0	0	0	0	0	0	0
	Shaft-Transverse	8	21	8	0	8	0	0	0	0	1	4	0	0	4	0	0	5	0	8	0	0	0	0	0	0	0	0
	Shaft-Oblique	10	18	9	1	8	2	5	0	2	6	0	5	0	0	5	3	14	15	10	[illegible]	0	1	0	5	5	0	0
	Lower Extremity	12	13	10	2	7	5	1	0	0	3	0	5	0	0	7	3	12	5	12	0	0	4	0	1	1	0	0
Radius	Shaft-Transverse	3	30	3	0	3	0	0	0	0	[illegible]	3	0	0	0	0	0	4	0	3	0	0	0	0	0	0	0	0
	Shaft-Oblique	7	28	7	0	6	1	0	1	5	2	3	4	0	0	0	3	4	7	7	0	0	1	0	0	0	0	0
Both Bones	Shafts Transverse	15	20	15	0	9	6	4	2	2	3	0	0	0	2	4	0	10	12	15	0	0	8	0	4	4	0	0
	Shafts Oblique	5	29	4	1	5	0	0	0	0	2	2	3	0	0	0	3	5	0	5	0	0	0	0	0	0	0	0
Ulna	Shaft-Transverse	2	18	2	0	2	0	0	0	0	0	2	0	0	0	0	0	4	0	2	0	0	0	0	[illegible]	0	0	0
	Shaft-Oblique	3	20	3	0	3	0	0	0	0	0	3	0	0	0	0	0	4	0	3	0	0	[illegible]	0	0	0	0	0
Femur	Shaft-Transverse	22	25	20	2	21	1	3	0	0	5	18	0	0	1	3	0	10	0	22	0	0	0	0	3	3	0	0
	Shaft-Oblique	42	26	34	8	28	14	3	3	1	12	0	37	0	0	5	4	12	18	41	0	0	5	2	5	3	1	1
Bones of the Leg	Tibia-Transverse	7	21	7	0	7	0	2	0	3	0	0	0	0	5	2	0	10	0	7	0	0	0	0	2	2	0	0
	Tibia-Oblique	34	29	32	2	20	14	8	11	3	10	0	4	0	22	8	3	11	33	34	0	0	10	15	8	8	0	0
	Fibula-Transverse	7	24	7	0	7	0	2	0	3	0	5	0	0	0	0	0	10	0	7	0	0	0	0	2	2	0	0
	Fibula-Oblique	34	29	32	2	20	14	3	2	3	10	20	0	2	0	0	0	10	25	34	0	0	10	15	3	8	0	0
Totals		263	X	231	29	201	62	33	22	22	81	69	103	3	31	31	X	X	X	262	0	0	39	32	31	28	1	15

Upper two-thirds — Incision along a line drawn from the tip of the trochanter major to the outer border of the patella.
Lower third and lower end — A vertical incision from either or both epicondyles. From abductor tubercle for popliteal space.

Tibia Subcutaneous from mesial tuberosity to tip of malleolus.

Fibula Incision through posterior peroneal septum along lower subcutaneous surface.

Figure 1 shows a fracture of the surgical neck of the humerus with the common displacement upward, forward, and inward of the proximal end of the distal fragment. The overriding is irreducible. My open reduction operation for this fracture is done through an incision along the mesial border of the deltoid. It is carried down to the bone, and the soft tissues are retracted so as to expose the surgical neck.

The fragments are replaced and grasped in my angular bone clamp (Fig. 17). A hole is bored obliquely upward and inward through the proximal fragment into the head of the bone to receive the long screw shown in place in Figure 2, which secures them. The clamp is removed and the wound is closed in layers, burying the screw. It is important carefully to suture the muscle sheath. A light shoulder cap splint is applied fixing only the shoulder-joint. The arm is held in a sling. Passive motion from the elbow down is started immediately. The screw is removed at the end of 3 weeks and motion of the shoulder-joint is begun. The shoulder splint is left off at the end of 4 weeks with the result shown in Figure 3.

Figure 4 shows an oblique fracture of the femur. This fracture is spiral if one component of the breaking force is tangent to the long axis of the bone. It is irreducible when muscle gets between the ends. My open reduction of this fracture is made through an incision on a line drawn from the great trochanter to the lateral border of the patella. The bone is superficial and is reached with little damage to the muscles. The fragments are replaced on a fracture table with the aid of extension and grasped in my clamp shown in Figures 5 and 18. Two holes are drilled transversely through both fragments to receive the screws shown in Figure 6 which secure them.

The clamp prevents the fragments from being separated by the screws. It is removed and the wound is closed in layers burying the screws. The sheath of the muscle is carefully sutured, the

limb is put in plaster from the foot to the waist. The screws are removed at the end of 4 or 5 weeks and the muscle sheath is again carefully sutured. Passive motion is begun. The result is shown in Figure 7.

Figure 8 shows a transverse fracture of the femur. The fragments are displaced with overriding and are irreducible by the closed method. My open reduction operation of this fracture is done through the same incision as for the oblique. The fragments are drawn out of the wound. Their ends are drilled transversely, and two heavy chromic catgut sutures are passed through from one to the other on opposite sides of the canal. The fragments are replaced, so that they fit end-to-end and the sutures are tied firmly in the manner shown in Figure 9. The wound is closed in layers with the muscle sheath carefully sutured. The entire limb is encased in plaster. The cast is removed and renewed in 3 weeks. It is left off when union is strong and gives the result shown in Figure 10.

Figure 11 shows a recent compound fracture of the humerus with osteomyelitis. The first step in this open reduction is a free incision with removal of necrotic tissue and detached fragments of bone. Drainage and disinfection are continued until the infection is under control. Then the fragments are fixed in position with a Lane's plate. The plate is removed as soon as the bone will stay in line. The drainage and disinfection are continued until the wound closes, Figure 12. There is loss of bone and frequently bone cavities with firm union as shown in Figure 13.

Figure 14 shows an old fracture of the tibia with fibrocystic disease of the bone and non-union following osteomyelitis. The open reduction of this fracture is through a vertical curved incision over the tibia making a lateral flap. The entire diseased section is removed cutting through healthy bone. A long graft is taken from the other tibia and inlaid deeply. The fibula is shortened in order to bring the cut ends of the tibia together and the graft is secured with bone pegs, Figure 15. The wound is closed and a cast applied to fix two joints. Figure 16 shows result.

I have chosen these descriptions of open reduction operations because they illustrate five important fractures. They occur frequently and therefore offer an opportunity for surgeons to agree on some standard procedure for their treatment. The precepts outlined have been carefully carried out in the operations given in Table II.

Open reduction cases are selected with great care. Those that are rejected are poor subjects and some will not stand violent efforts at closed reduction. Firm splints and bandages will cause ischæmic paralysis. The surgeon should advise these patients that he can obtain a fair result and may get deformity with some loss of function.

CONCLUSIONS

Fractures of the long bones with displaced and overriding fragments are seldom reducible by the closed method and suggest open reduction.

Operability must be determined in all cases.

No operation should be undertaken in acute disease or infection.

Chronic disease or infection must first be treated and may reject operation.

Arrested local disease foci in bone must be excised through healthy tissue without disturbing their contents.

Operation should be delayed about 2 weeks in recent injuries.

No operation should be performed with carbon dioxide combining power of the blood below 40 cubic centimeters. This capacity should be raised in all cases before operation with an intravenous injection of sodium hydroxide.

Small detached fragments must be removed at operation.

The fragments of a recent oblique fracture of a long bone should be fixed with screws.

The fragments of a recent transverse fracture of a long bone should be sutured by my method.

Fracture of the surgical neck of the humerus should be fixed with a screw.

Fragments of the radius, ulna, and fibula are best secured with sutures.

Oblique fractures of the lower end of the humerus with displacement are irreducible by the closed method, and the fragments are best secured with a Lane plate placed posteriorly.

The fragments of all compound fractures should be fixed with a Lane plate or Smith's clamp and the wounds opened wide for drainage and disinfection.

All screws and plates should be removed as soon as the fragments will remain without their support.

Old fractures of long bones with non-union should be united with long inlay grafts.

Bone cavities with chronic sinuses are cured by breaking down their walls and implanting bone or muscle to fill them up.

APPARATUS FOR IMPLANTATION OF RADIUM EMANATION POINTS

By ROBERT M. LEWIS, M.D., Baltimore

In treating certain types of malignant tumors with radium, the implantation of minute capillary glass containers filled with emanation is more efficient than is any form of surface application. If the growth is found on the surface of the body or at a point that is easily reached, the introduction of the emanation is a simple matter. The emanation, or active gas given off from the radium, is transferred by a mercury pump into a fine capillary glass tube about 3 to 4 millimeters long, which is then sealed, sterilized with alcohol, and placed in the end of a sterile, hollow needle for introduction into the malignant growth. The needle, acting as a carrier for the emanation point, is now plunged directly into the tissues to the desired depth, and the glass point or spicule is then dislodged with an obturator or stilet of wire and the hollow needle carrier is withdrawn, completing the little operation. As a rule, such a minute glass particle does not act as an irritant but remains harmlessly imbedded in the tissues after the emanation has spent itself, which takes place in the course of a few days. Only a small amount of emanation—say from 2 to 5 millicuries (1 millicurie is the equivalent of a milligram of radium) is implanted in each spicule.

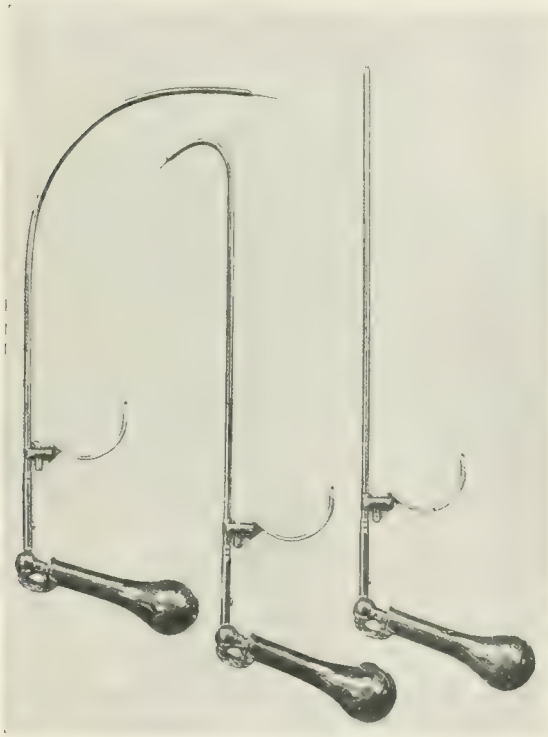

Fig. 1.

To demonstrate the comparative efficiency of surface and implantation treatments, a patient with lymphosarcoma, whose entire body was covered with subcutaneous nodules of disease, was recently treated. Two masses, each about half the size of a hen's egg but nowhere near each other, were chosen for the test. The one was treated by the introduction of a 4-millicurie point, the other in the more usual way with nearly 4 grams of radium held at 1.5 inches from the tumor for 20 minutes. In five days' time both masses were about one-fourth their original size. A month later only a very little induration, representing the original tumors remained.

Growths in certain sites, for example those in the bladder, thorax, or the nasopharynx, are difficult to treat effectively and with precision and perfect accuracy by direct surface application of packages or by the usual instruments for implantation. For such cases I have found it necessary to devise special instruments, which would work through a cystoscope or around corners involving different curves. It was simple enough to have made the straight instrument shown in the photograph. The construction of the curved ones, I found more difficult.

The straight instrument is used to implant in bladder tumors. The larger curved instrument is designed for laryngeal work, while the remaining one is arranged to treat tumors in the nasopharynx. In each a stilet is attached to the trigger to push its (the end of the stilet) end out flush with the end of the needle, thus forcing out and imbedding the emanation in the tissue. Before using the apparatus, alcohol sterilization is sufficient. The tiny emanation containers are laid in the hollow needle in front of the plunger. A little sterile vaseline on the needle point prevents the contained point slipping out accidentally.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

JOINT MEETING OF THE CHICAGO SURGICAL AND CHICAGO NEUROLOGICAL SOCIETIES, HELD JANUARY 2, 1920, DR. CHARLES E. KAHLKE, PRESIDING

FALSE ANEURISM OF INNOMINATE ARTERY

DR. A. E. HALSTEAD: Thomas F. Kielty, Corporal, Co. M., 168 Inf., was injured September 12, 1918. While in action in the Toul Sector, the patient ran forward and was hit by a machine-gun bullet. The machine gun was about 600 yards in front of him. The bullet entered the patient's neck about 4 centimeters above the sternoclavicular junction and 3 centimeters to the right of the median line; it left his body through the back at the junction of the third and fourth dorsal vertebræ, 4 centimeters to the right of the median line. He fell, did not lose consciousness, got up, and then walked back 1 mile. Immediately after the injury, his neck began to swell, his voice became low, and he expectorated a small quantity of blood during the first 3 days after the injury.

On admission to Base Hospital No. 68, on September 16, examination showed a swelling of the neck in the region of the thyroid gland and resembling it in outline. The swelling was greater on the right side than on the left. There was a slight bruit over the right side of the swelling. The neck was stiff, deglutition difficult; he was able to swallow only very small particles of solid food; inspiration was difficult, the voice was weak and low; there were diffuse ecchymoses on the upper chest; slight pain; no paralysis; urine negative; white blood cell count on September 26, 16,550.

The patient's chief complaints were (1) difficult breathing; (2) almost complete loss of voice (examination of larynx on September 23 showed a paralysis of the abductors of the right vocal cord); (3) swelling and stiffness of neck (circumference of neck over point of wound, 58 centimeters).

Operation on September 26. The patient was asphyxiated at the time he entered the operating room. An incision was hurriedly made over the most prominent part of the tumor. Violent hæmorrhage followed. The index finger was introduced and the opening in the vessel found. It was on the superior surface of the innominate artery close to the origin of the carotid, and was about half the size of a dime in diameter. The clots were evacuated. The hæmorrhage was controlled temporarily by the finger in the vessel and by means of pressure. The inner end of the clavicle was disarticulated and 2 inches of clavicle resected. The upper end of the sternum for 1.75 inches was removed with rongeur forceps. The wound was sponged dry. No. 0 chromic catgut sutures were used to close the opening in the vessel.

The postoperative condition has been favorable; there has been gradual improvement in health, and the patient's voice is regaining its power slowly. About November 10, 1918, he was out of bed, having regained his former strength and full power of voice.

In the literature only 2 cases are to be found in which, because of injury to the vessels close to the innominate artery, ligature or suture of the innominate artery was resorted to. Of these, one was a stab wound of the inferior thoracic artery and one a gunshot wound of the common carotid artery. Both of these were treated by ligature of the innominate artery and both died. For wounds of the innominate artery itself 3 cases are reported: 2 followed by immediate death and 1 by death on the eleventh day. In none of these was surgical interference attempted.

The first case was reported by R. H. Harte.[1] E. I. colored, laborer, age 26, admitted to Pennsylvania Hospital, May 31, 1896. The patient had received a pistol shot wound in the neck, the shot being fired from a distance of 4 feet. The shot entered the neck on the left side 1 inch above the level of the clavicle. A probe entered 1.75 inches. The patient could not move the left arm.

An incision was made on the right side of the neck, posterior to the sternomastoid. The ball was found in a pus pocket, close to the œsophagus behind the carotid artery and just above the origin. On the third day food regurgitated through the wound; on the eleventh day there was a hæmorrhage. The wound was packed. On the thirteenth day there was a hæmorrhage. The innominate, subclavian, and carotid arteries were ligated. The internal jugular vein ruptured and was ligated. Death followed in a few hours. Autopsy showed ulceration of the œsophagus and cervical vertebræ, abscess of the right temporosphenoidal lobe and right frontal lobe.

The second case was reported by Hutin.[2] N. C. soldier, wounded in the right axilla by scissors

[1] Harte, R. H. Ann. Surg., 1897, xxvi, 489.

[2] Hutin [illegible]

blade. A severe hæmorrhage was stopped by packing. The packing was removed the same day. On the fourth day there was another hæmorrhage, which was stopped by packing. There were three hæmorrhages during the following 8 days. On the twelfth day the patient had a violent hæmorrhage with pain in the axilla. Pressure on the axillary artery controlled the hæmorrhage. The subclavian artery was tied. The patient remained well for 5 days. In straining at stool on the sixth day, the subclavian ligature came away and hæmorrhage followed. The innominate artery was ligated. Death on tenth day. Autopsy showed only inferior thoracic artery injured.

The third case is reported by E. W. Walker.[1] J. C. male, admitted to Cincinnati Hospital with gunshot wound above the center of the left clavicle. There was slight ecchymosis about the wound, marked swelling of tissues above the right clavicle, shock, and pain. At entrance there was little hæmorrhage. An ice bag was applied and the patient kept quiet. On the first day temperature developed following a chill. Later the patient coughed but the sputum was not blood stained. On the sixth day erysipelas developed. Death on the eleventh day.

Autopsy showed that the bullet fractured the left clavicle one-fourth inch from the left sterno-clavicular articulation; lodged at apex of the right pleural cavity, three-fourths inch above the upper border of the first rib, one and one-half inch from the costovertebral articulation. There was a wound, three-fourths inch long, one-fourth inch wide, of the innominate artery one-fourth inch below termination on posterior aspect. The wound was closed by a clot one-fourth inch thick by 1 inch wide, extending into subclavian and carotid arteries. The right lung was completely collapsed from effusion.

A fourth case was reported by L. R. Erwin.[2] The patient had a stab wound one-half by three inches. The weapon entered transversely above the right sternothyroid muscles and divided the innominate artery in two-thirds of its diameter, close to the bifurcation. The wound extended through the trachea and œsophagus and terminated one-fourth inch in the body of a cervical vertebra. There was hæmorrhage through the incision, mouth, and nose. The author quotes another case similar to this. In this instance the man walked 30 yards before falling. Death.

SYMPOSIUM ON PERIPHERAL NERVE INJURIES

Dr. G. Carl Huber, Ann Arbor, Michigan, read a paper on "Repair of Peripheral Nerve Injuries." (See p. 464.)

Dr. Lewis J. Pollock read a paper on "The Clinical Signs of Nerve Injury and Regeneration." (See p. 472.)

[1]Lancet-Clinic, Cincin., 1881, vii, 49-51.

[2]Erwin, L. R. Am. J. M. Sc., 1872, lxiii, 281.

DISCUSSION

The discussion was opened by Dr. Dean Lewis, who presented the "Surgical Aspects of Peripheral Nerve Injuries."

SURGICAL ASPECTS OF PERIPHERAL NERVE INJURIES

Dr. Dean Lewis: I believe that I can best illustrate the points that I wish to emphasize by demonstrating different types of nerve injuries which have been operated upon.

This patient was wounded in the Argonne Forest, October 27, 1918. A shell exploded near him, wounding him in four places. The internal condyle of the left femur was removed, a large wound over the outer and posterior aspect of the left shoulder was excised, a fragment of high explosive entered the posterior surface of the sacrum, and the right musculospiral nerve was divided about 3 or 4 inches above the elbow-joint. The musculospiral nerve was sutured on February 21, 1919. Two tension sutures of catgut were placed through the nerve, and the epineurium closed with fine catgut. Approximately 4½ months after the nerve was sutured, there appeared the first evidences of return of motion. This was associated with marked hyperæsthesia of the skin supplied by the musculospiral nerve. I believe that this may be regarded as a complete return of function, for the patient can place the palm of the hand forward, with the little finger adjacent to the seam in the trousers leg with all the fingers extended and in line. This is only possible when the supinators, the extensor communis digitorum, and abductor longus pollicis function.

This man was wounded in Belgium during the first week of November, 1918. He passed through Evacuation Hospital No. 5, having sustained a machine-gun-bullet wound of the right arm which did not fracture the humerus. Dry dressings were placed upon the wounds of exit and entrance. Both of these healed rapidly. The musculospiral paralysis which came on immediately has not improved. When the musculospiral nerve was exposed, it was found divided and driven into a hole in the bone which the bullet had evidently perforated without fracturing. After the ends of the nerve were exposed, the scar tissue was resected, and an end-to-end union by means of epineural sutures was made.

Within 5 months after suture there was a decided return of motor power. This is most marked in the radial extensors of the wrist. Extension of the fingers is still limited and there has been little if any return in the abductor longus pollicis.

An interesting thing about this case is that a neuroma through which regeneration has occurred developed at the point of suture. A distinct neuroma painful upon pressure can still be felt, but it is decidedly smaller now than a few weeks ago.

The next patient was wounded in the Argonne Forest. He sustained a compound fracture of the

left humerus near the middle. This was accompanied by a musculospiral paralysis. He was operated upon April 15, 1919. When the nerve was exposed in the musculospiral groove a relatively large sequestrum was found in the humerus. This was removed; tincture of iodine applied to the cavity; and an end-to-end suture of the nerve made after the neuroma and scar tissue had been resected far enough back to permit of herniation of healthy appearing neurofibrillæ. The wound was then closed. Much to my surprise healing by first intention occurred. Within the last two weeks there has been a decided return of motor power. He is now able to extend the wrist and when flexion of the forearm is attempted the supinator longus is thrown into action. The first evidences of return of motor power were noted 2 weeks ago.

This patient was also wounded in the Argonne Forest. A machine-gun-bullet entered the anterior axillary fold low down, and made its exit over the triceps muscle posteriorly. The musculospiral nerve was divided on the inner side of the arm before it enters the groove. It was sutured April 22, 1918. Return of motion was noted approximately 5½ months after suture. One night the patient put his hand outside of the bed clothing and attempted to extend the wrist. Much to his surprise he found that he could move it. This was the first evidence of return of function.

This patient was wounded in the Argonne. He sustained a fracture of the left humerus (machine-gun-bullet) accompanied by a paralysis of the musculospiral nerve. It was impossible to determine by clinical examination whether there was a physiological or anatomical division of the nerve. However, no neuroma could be found along the course of the nerve. The nerve was exposed on the 20th of April, 1919, and was found imbedded in scar tissue and callus. When the nerve was dissected free, it had a frayed appearance. Four funiculi, however, passed from the upper to the lower segment. It was thought inadvisable to attempt resection because these funiculi were intact and if resection were attempted, it would be difficult to make an end-to-end suture. Muscle neurolysis was, therefore, performed. He now has return of motor power in the extensors of the wrist; and beginning return of power in the extensor communis digitorum. There is still no return of power in the extensor longus pollicis.

This patient has a large scar upon the inner surface of the left arm in the upper third. He presented the typical picture of combined ulnar and median nerve palsy when first examined. The nerves were exposed on March 18, 1919. There was considerable lymph œdema of the arm. Both nerves were divided and the ends separated by a considerable distance. After mobilization of the nerves, an end-to-end suture was performed.

There was noticed shortly after the operation considerable improvement in the appearance of the hand. There has been, as you can see, almost complete return of function of the muscles supplied by the median nerve. Flexion of the fingers is almost complete. The atrophy of the thenar group of muscles is not so marked and there is distinct return of power, which is increasing rapidly, in the opponens pollicis. It is also interesting to note that in this case a neuroma can be palpated at the point of suture in the median nerve.

This patient was wounded in the Argonne Forest on September 22. He sustained a high explosive wound of the tarsus of the left foot and of the posterior surface of the right thigh, the sciatic nerve being completely divided. An end-to-end suture of the sciatic nerve was performed on March 19, 1919. A defect of 7.5 centimeters was overcome after the nerve ends were mobilized and the knee flexed to a right angle. The knee was kept in this position 4 weeks before any attempt was made to straighten the leg. Even then the leg was extended gradually. He first noted return of motion in the muscles of the calf 6 weeks ago. Distinct contraction can now be felt, but the muscles supplied by the external popliteal nerve are still paralyzed. The atrophy of the leg is much less marked, and the function in the group of muscles just mentioned improves rapidly.

This next patient was wounded October 5, 1918, and presented the symptoms of a complete sciatic lesion. He was operated upon July 30, 1918. The sciatic nerve was exposed, but was not found divided. A muscle neurolysis was performed. There are now distinct evidences of recovery of motor power in the muscles of the calf, and there is also some evidence, not marked, of return of motor power in the anterior group of muscles.

This patient sustained an injury of the ulnar nerve, which was divided. An end-to-end suture was performed July 1, 1918. The flexor of the little finger is still paralyzed, but I think that there are distinct evidences of return of function in some of the small muscles of the hand. The general appearance of the hand is much better.

The best results after suture have been obtained in the musculospiral, the median and sciatic. There are evidences of return of function in some cases in which the ulnar nerve has been sutured. There has been return of function in but one case after suture of the external popliteal and in this case return of motion, which was almost complete, was noted after 5 months.

I wished to present three cases of causalgia, but it has been impossible to get these patients because they have left the hospital. These three patients were cured by intraneural injection of 60 per cent alcohol. In two cases the median nerve was injected and in one the internal popliteal and long saphenous nerves. This procedure is so simple and the results are so satisfactory that it is to be preferred to periarterial sympathectomy advocated by Leriche. Whenever neurolysis is attempted in causalgia, it should be combined with intraneural injection of 60 per cent alcohol. Neurolysis alone does not control the pain in many cases and even

in those in which there is some relief, it is apt to be but temporary and the pain may recur with the same or greater severity.

In performing nerve suture the neuroma and scar tissue should be resected far back. The resection should be carried far enough back to permit healthy appearing neurofibrillæ to herniate. Hæmorrhage should be controlled, so that a dry field is maintained. When the suture is completed the epineurium should be closed so that the neurofibrillæ cannot stray or scar tissue invade the line of suture. The suture should be made with little or no tension. After the suture is completed the nerve should be placed when possible in a new muscle bed. The dissection should be made when possible along intermuscular septa so that the muscle fibers of these muscles which may later be needed to form the new bed for the nerve are not cut. It is not necessary to use any of the numerous methods to cover the suture line which have been advocated.

Neurolysis is an operation which is of distinct value. It may be combined with capsulectomy and parallel incision of thickened epineurium in certain types of cases. Muscle neurolysis is, I believe, the best operation. In this operation an attempt is made to place the freed nerve between healthy, nonbleeding muscle. The dissection must, therefore, be made when possible along intermuscular septum. I believe this method preferable to neurolysis by fat, fascia, Cargile membrane, or formalinized calves' artery.

Where the defect is so long that end-to-end suture cannot be performed, the auto-cable transplant, which has been tried out so satisfactorily and convincingly by Dr. Huber, is the operation of choice. I believe that I have two cases in which there are decided evidences of return of function after the use of the auto-cable transplant.

Dr. Ernest Sachs, St. Louis, Missouri: One point should be mentioned and that is that the handling of nerves is a very different sort of thing than that we are perhaps accustomed to employ with other tissues of the body. A nerve must be handled with great gentleness when it is to be sutured; second, what in my experience is very important, the nerve should be kept warm and not permitted to become chilled, which is accomplished by wrapping it up in hot cotton during the period of operation which is usually a long and tedious one.

The only phase of the work on which I have had any experimental experience confirms absolutely what Dr. Huber has said, namely on the use of fat. It was first described by Rehn who emphasized its great value in applying it over defects in the brain. Some eight years ago I tried that out experimentally and became convinced that his observations were absolutely wrong; that the fat was completely replaced in a short time by a dense mass of connective tissue, and in several cases in which I applied this clinically, I had an opportunity later on of opening the wound again and found that the same thing had occurred.

One point that Dr. Pollock brought out of the many interesting ones he presented is the emphatic way in which he showed that it is impossible to tell whether a nerve is anatomically or physiologically divided. That seems to me a valuable contribution. So frequently in articles and in textbooks men seem to beat around the bush on that subject. What he said about the length of time after which a nerve may still regenerate is a statement that I do not question, but one that might lead to faulty treatment surgically. Even if it is possible for a nerve to regenerate 7 or 8 months after an injury, I do not believe it is advisable to wait as long as that before determining whether or not the nerve is absolutely divided. If Dr. Pollock believes that, I must take issue with him. If the evidence is present that the nerve is completely blocked, I believe the proper procedure is to explore the region of the injury and determine the nature of the block, and, if necessary, take steps then to correct it.

What he had to say about the time of recovery of a nerve I do not wish to discuss with him because he has this very large material, but anybody who has busied himself for a long time with neurology cannot help but feel a little disconsolate, when a certain thing we have banked on for many years has been undermined; in other words, certain props have suddenly been knocked from under one. I refer particularly to what he said about the work of Head in regard to peripheral nerve disturbances. His evidence is extremely interesting, it is difficult to contradict, but it seems to me has not absolutely refuted the work extending over many years of Head and his various co-workers. I do not quite see how he explains the return of sensation, for example in the ulnar anæsthetic area by the overlap, for, it seems to me, that if the overlap controls a large part of that area, the overlap ought to be present immediately after the injury. In other words, the only anæsthetic area ought to be the exclusive area supplied by the ulnar nerve. As I understand his observations, and I have read his article on the subject, there is a wider loss of sensation at first and after a short time some sensation returns in that area due to the overlap. I cannot quite see why the anæsthetic area from the very beginning should not correspond to the exclusive area supplied by the ulnar nerve as he has worked it out.

Dr. G. Carl Huber (closing): I can readily see that there may be an apparent overlap in sensory areas more than is generally recognized. The sensory nerve supply for a particular area, for instance, the peripheral ulnar field, need not be exclusively supplied by the ulnar; other bordering nerves may be educated in the course of a few weeks to give perception from the borders of the same area. I am confident that it is not necessary in practical work to give undue stress to Stoffle's studies on the specific funicular structure of nerves. Any one who has worked experimentally with regeneration of nerves realizes that from 10

to 50 new neuraxes may bud toward the periphery from a single central neuraxis, and 15 or 20 new neuraxes are often found centrally in a single old neurilemma sheath. No matter how carefully primary suture is made, there is a great tangle of these new nerve fibers as they pass through the connective tissue of the wound, and especially is that the case with secondary sutures. A large number of fibers pass from the stump along the transplant in the connective tissue surrounding the transplant. I am sure, sensory nerve fiber branches reach the motor nerves; and that central motor nerves reach the distal sensory nerves and are maintained for a time. They make no distal connection and in time degenerate. I am confident there is never complete regeneration of the peripheral stump, and to some extent there needs to be re-education of the nerve centers after every regeneration of the peripheral stump. The anatomic findings often give very distinct motor and sensory recovery without full functional return.

Dr. Pollock (closing): In reference to the first criticism of Dr. Sachs, I believe that with certain reservations it is well taken. I did not wish to be understood as saying that operative procedures were contra-indicated within a period of from 8 to 9 months following the injury. What I meant was that if an injury of a peripheral nerve which had produced a complete physiological interruption was spontaneously recoverable, it was a mistake when operative interference was instituted to perform a resection and suture, even if 8 or 9 months had elapsed from the time of injury. Such procedures as exploratory operations and neurolyses were by no means contra-indicated.

It is impossible to discuss at length the question of the function of nerve overlap in a limited space of time. However, I might point out several facts: First, although the work of Head and his coworkers has been accepted fairly largely in ordinary physiologies and is a matter of common acceptance among many neurologists, yet recent studies have shown that this work is not incontrovertible. Second, some recent physiologies are bold enough to throw some discredit upon this work. I maintain that the dissociated and relatively early return of sensation to pin prick is not due to a supposed early and miraculous regeneration of protopathic fibers, but to the assumption of algesic function of adjacent and overlapping nerves.

The extent of this overlap can be determined by establishing the extent of residual sensibility. Residual sensibility is that sensibility remaining in an area of skin when all the nerves adjacent to the one being studied have been severed. For example, if we have a combined lesion of the internal saphenous and the internal popliteal, what sensation is left can be supplied only by the external popliteal. If, therefore, the web between the toes and that part of the sole adjacent to the web is sensitive to pain under the above condition, the external popliteal nerve supplies this area through its overlap. If the median, ulnar, and musculocutaneous nerves are severed, that part of the palm which is sensitive to pain must receive an overlap supply from the radial. No return of pain sense within an area of possible overlap of an adjacent nerve can be attributed to regeneration unless touch sense returns as well.

It is evident that if sensation has returned on the radial part of the palm after an injury to the ulnar and median nerves, and if these nerves subsequently be resected and sutured and the sensibility still remain, this sensibility cannot be due to any regeneration of these nerves. Why sensibility to pain within an area of nerve overlap does not appear immediately following injury of an adjacent nerve can only be determined by psychophysiological investigations. The fact remains that this sensibility returns gradually and subsequent section and suture does not affect it.

It seems to me that, if we find this return of pain sense only in the areas which we have shown to be parts of the residual sensibility of adjacent nerves, that if this sensibility never appears if the adjacent nerve be injured at the same time, that this sensibility disappears if the adjacent nerve subsequently be sectioned and, finally, that this sensibility is not affected by subsequent section and suture of the injured nerve, my point that this return of sensation is not due to regeneration, is proven.

CORRESPONDENCE

ISTITUTO ORTOPEDICO RIZZOLI, BOLOGNA

Notice of Contest

To the Editor:—The contest for the Umberto I prize has been opened. A prize of 3,500 lire will be awarded, in accordance with the decision of the Provincial Council of Bologna, for the best orthopedic work or invention. Italian and foreign doctors may enter the contest. Arrangements for the contest and for the assignment of the prize are explained in the regulations, a copy of which will be sent upon request. Applications for admission in the contest should be made to the President of the Rizzoli Institute in Bologna. The contest will close December 31, 1920.

Bologna, Italy. G. Zanardi, *President.*

EDITORIAL

SOUTH AMERICAN SURGEONS

THEODORE ROOSEVELT, with characteristic courage and vigor, overcame all opposition and caused the Panama Canal to be built. The dream of nearly five centuries was realized. The whole world is forever Roosevelt's debtor. By the severance of the land connection between North and South America these two continents are now united as never before. The long, hazardous routes of travel of the olden time have been replaced by new ones, safe and speedy. The great war came so quickly after the completion of this epoch-marking achievement that it has not as yet touched Pan-American imagination.

Having returned recently from a trip to South America where, in company with Dr. Franklin H. Martin, I visited some of the important surgical clinics of Peru, Chile, Argentine, and Uruguay, where we became acquainted with and observed the methods of many surgeons, I take this early opportunity to pay merited homage to these men of science, learned in surgery. It is but just to say that in their hospitals and operating rooms they are the equal of any representative group from any country in the world. They have that intuitive clarity of thought and facile mastery of technique which we associate, and rightly, with the French and Italian schools. The surgeons of South America have recognized for a long time the necessity of frequent clinical trips to observe the work of foreign surgeons; of late years many of them have come to the United States; it has been always a pleasure to know them.

Their medical schools are splendid institutions with a seven-year course, and are the equal in equipment and methods of theoretic teaching of any in the world. In South America "Commencement Day" means just that, for after graduation the young surgeon begins a special course of surgical training. Instead of carving his way to knowledge and experience by the scalpel, he is tutored for a period of from eight to ten years along lines which we of the United States have accepted only recently under the general term of fellowships in graduate medicine and surgery.

The hospitals of South America are imposing, built for the tropics, and associated with the medical schools. The hospital records are the best I have ever seen; this is true of every hospital we visited, small or large.

The reception given us by our South American confrères was most cordial, and we came away with not only admiration for the South American surgeon as a surgeon, but also with a feeling of personal friendship for him that will last for life. Whatever may be the after-war responsibility of the United States abroad, we can not question that our first duty is to develop a sound Pan-Americanism.

A Pan-Americanism of science, a unity of the spirit and ideals, will be more lasting than measures based on financial, commercial, or political considerations.

William J. Mayo

SOUTH AMERICAN SURGEONS

A Trip in Behalf of the American College of Surgeons by Dr. William J. Mayo, President, and Dr. Franklin H. Martin, Secretary-General.
Jottings of the Secretary-General—Continued

By FRANKLIN H. MARTIN, M.D., F.A.C.S.

I. ACTUAL SURGERY

"WHAT about the surgery you witnessed?" This is the question most frequently asked. Unfortunately, we had but one or two opportunities to see the surgeons at work. One morning, in the course of hospital inspection, we saw three operators at work in as many institutions. The first surgeon was operating on an ectopic pregnancy, in which a primary rupture had occurred, and the patient was exhausted by the serious hæmorrhage. The operation was skillfully performed. In another operating room the surgeon was doing a careful dissection on a strangulated inguinal hernia, under a local anæsthetic. An eight-inch, gangrenous intestine was revealed. The operation was ably managed under surroundings that were perfectly safe, although the operator was undoubtedly surprised at finding himself the observed of the premier surgeon. In a neighboring hospital we witnessed an appendectomy. A gangrenous appendix was removed in the routine way. The morning's observation revealed surgery equal to that of the best hospitals of New York City, Chicago, and Rochester.

In other cities we witnessed parts of procedures, and in each instance the surgery was apparently of the highest class. I am quite sure that Lima, Santiago, Valparaiso, Buenos Aires, or Montevideo could entertain a surgical society of the United States or Europe and give a surgical demonstration that would reveal a broad experience, approved facilities for diagnosis, recognized technical ability, and a fundamental knowledge of surgery that could not be excelled anywhere.

II. PANAMA

It is now well recognized that the Panama Canal could not have been completed if it had not been for the sanitary regulations that were devised and enforced in connection with the work of digging and constructing. The Medical Corps of the United States Army was responsible for this accomplishment. This Corps, through the self sacrifice of its members, revealed the course of malaria and yellow fever, and discovered and applied the remedy. The miracle of the completion of the Panama Canal could not have been attributable to Theodore Roosevelt alone even if it had been necessary to occupy much more territory; nor to General Goethals alone even if the Culebra slides had been multiplied ten times; but to that lovable man who, with his associates of the Medical Corps of the Army, applied the rules of modern sanitation, rules based on fundamental discoveries, and administrative regulations formulated by this same great scientist, Major General William C. Gorgas.

III. MAJOR GENERAL WILLIAM C. GORGAS, M.C., U.S.A., RETIRED

One does not wonder that General Gorgas loves the beautiful spot that his genius made possible, and that he saw rise from a tropical jungle of pestilence to a paradise for men—the destined garden spot of the world.

Once while General Gorgas and the writer were waiting for an interview in the office of the Secretary of War, we spoke of the horrors of the war in which we were both so busily engaged. I remarked to the General that it must seem to him that fate had pursued him pretty closely; after all the work he had done in sanitation to be suddenly called upon to raise an army of civilian doctors for the greatest war of history. "Yes," he said, "I wish the horrible war were over." I said, "What is the very first thing that you would do, General Gorgas, if tomorrow morning, before arising, you should receive a telephone message assuring you that the war was ended?" "Do you know what I would do?" he asked, while his eyes had a far-away, wistful expression. "I would ring off, call New York City, and order a passage for South America. I would go to Guayaquil, Ecuador, the only place in which yellow fever is prevalent, exterminate the pestilence, and then—and then return to Panama, the garden spot of the world, and end my days writing an elegy on yellow fever."

And this was not the mere day-dreaming of a man overwhelmed by a stupendous job, but the real yearning of a peace-loving man, who, within a month after the armistice, accepted a commission from the Rockefeller Foundation to go to Guayaquil, Ecuador, to do the very job that he wished to do.

While Dr. Mayo and I were visiting the President of the Republic of Peru, he spoke affectionately of General Gorgas and said that three of the South American Republics—Peru, Ecuador, and I believe Colombia—had appointed General Gorgas the official Inspector-General of Sanitation for the western coast. Unfortunately, we missed General Gorgas at Panama, as he was on his way south and we had passed each other en route without realizing it.

IV. SEÑOR JAVIER PRADO

We were afforded the pleasure of visiting Señor Prado at his palatial home, with its private museum containing antiquities of the ancient Peruvians and of the Incas of the pre-Peruvian age. Señor Prado is a son of a distinguished Peruvian who was President of the Republic at the time of the last war between Peru and Chile. He has gathered one of the most complete collections of ancient Peruvian pottery now in existence. Many rooms of his home are filled with unusually beautiful coco bolo and mahogany carvings. His art gallery contains some of the finest works of Peruvian painters. He has collected from France and Italy excellent bronzes, marbles, miniatures, cameos, and fans. One of the sleeping rooms is a marvel with carved furniture and cabinets of native coco bolo and mahogany, while the polished floors are covered with some of the most perfect Vicuña rugs that we saw in South America. From the windows one viewed the patio, which is a particularly artistic feature of this palace which is situated in a country where tropical gardens of great beauty are seen everywhere. An interesting room is one which contains many busts and the family portraits, a number of which are likenesses of his illustrious father in the gorgeous uniforms of his time with many decorations. Señor Prado is a most charming host, and he is extremely modest in exhibiting his treasures. One of the marvels of his collection is a room filled with the skulls of Inca chiefs, many of them having been distorted and reduced by cunningly devised pressure apparatus used by these aborigines. The Señor's secretary brought two of these precious skulls to Dr. Mayo and myself at our hotel in Lima. These are mementos that we shall prize forever as reminders of an enjoyable visit to a most interesting man.

V. HONORARY FELLOWSHIPS

Honorary Fellowships in the Sociedad de Cirugía del Perú were conferred upon Dr. Mayo and myself, under interesting auspices. The ceremony occurred in the main lecture room or amphitheater of the Medical Department of the University of San Marcos. This university, by the way, was established just one hundred years before the founding of Harvard University, making it by far the oldest university on the two American continents.

We assembled in the main lecture room, on the large platform of which were the members of the Sociedad de Cirugía and of the Faculty of Medicine of the university. The President, Dr. Juvenal Denegri, occupied a seat at the center table, with Dr. Mayo and myself at either side. Flanking us were the members of the Faculty and of the society. On the main floor or amphitheater were about two hundred students. The back of the amphitheater opened onto a court filled with tropical plants, palms, and flowers. This could be seen through an attractive colonnade which outlined the assembly hall. The students, a splendid group of young fellows, were in their places when we entered and filed onto the platform. They rose in a body and cheered and applauded for several minutes. It was a reception that was rather stirring, and warmed our hearts to the future medical profession of Peru.

The President, Dr. Denegri, read an address of welcome to the two candidates for Honorary Fellowship. In the meantime, we had received copies of the English translation of the address. A second address was read by the Secretary of the Association, Dr. Francisco Grana. The Honorary Fellowships were then separately conferred by the President, and engraved parchment certificates presented to us as evidence of this honor.

As Dr. Mayo rose to speak, he received an ovation from the Faculty and students that plainly deeply touched him. It was some time before he was allowed to express his pent-up feelings and to say to them how much we appreciated their great hospitality and especially the honor they had just conferred upon us. He then described the object of our visit to South America. My own talk was received with an enthusiasm that I was at a loss to understand. In responding, the most I could do was to congratulate everybody on something: the splendid body of students for being educated in the oldest university on the Western Hemisphere, in a medical school with a seven-year course; the Faculty for being privileged to teach in the university, with such an attractive student body; Dr. Mayo and myself for being so fortunate as to be privileged to visit this institution and to receive such a reception. The brief talk was suddenly termi-

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MAJOR GENERAL W. C. GORGAS, M.C., U.S.A. (Retired)

A Builder of the Panama Canal

nated and was followed by the most enthusiastic applause, too much for the conventional and rather commonplace talk. It occurred to me that there was some compensation in being brief and in speaking in an unknown tongue. It transpired, however, that these were not the reasons. It seems there has been quite a partisan controversy in the medical department over the length of the course, viz., the seven-year requirement for a medical degree. This had been discussed pro and con with considerable feeling, the students being divided into two factions, one opposing the long course and the other upholding it. In congratulating them on the seven-year course, I had used the sign language by holding up seven fingers to emphasize my speech. Each of the two groups to the controversy interpreted my remarks as favoring its contentions; hence the outbreak. As a matter of fact, Dr. Mayo and I soon found that our talks when brief and least understood were most heartily received.

VI. IMPORTANCE OF STANDPOINT

Dr. Mayo, as we all know, is the philosopher of practical surgery. We may not have thought of him as a philosopher-poet, but on a number of occasions on this remarkable trip of ours the claws of practicality were padded, and in the purple atmosphere of the southern continent the poet emerged. "In coming to South America," he said to the Secretary of State of Uruguay, "we have succeeded in changing our standpoint. In our northern continent we live under the polestar, and our whole view is from the standpoint of the northern heavens. Now we have visited and viewed for the first time the heavens of the southern cross, and with this experience our range of vision has been broadened and the expanse of our standpoint has been doubled. In the future, America will mean to us all-America, including that under the polestar, and no less that under the southern cross."

VII. SURVIVAL OF THE FITTEST

How little do we know of the people of the southern continent! We were accustomed to thinking of them as the inhabitants of a number of small republics which would compare in area to so many of the states of our own country. In our ignorance we considered them, of necessity, more or less provincial. Our idea is now changed. Instead of being provincial in their attitude toward life, we found the peoples of South America to be the broadest and most cosmopolitan in the world. And why shouldn't they be? The continent of South America, including the Central American states, was the first to be explored by European countries. Taking Peru as an example, review for a moment its history. It had an ancient civilization that antedated by several centuries the discovery of America. This race was overrun, and after a prolonged struggle it was conquered by armies of Spain, led by the most competent adventurers. With the subjugation of the Incas, the Europeans intermarried with this strong race of natives, and for four hundred years this melting-pot has been fed by the men and women of vision and adventure of Europe—England, France, Italy, Germany, and Holland—and from it has emerged a strong nation of self-reliant Peruvians, which represents the survival of the fittest of centuries of evolution.

And that is how they appear! They are of strong physique, self-reliant in attitude, their strength of character predominates, and they are ambitious for self-education; they are not satisfied to retain a local outlook; they are not as we are prone to be—selfish in our preparation for intercourse with the world; they, most of them, know and cultivate at least two continental languages besides their own; they seek a classical education at home and supplement this with world travel and study abroad; they are people of strong temperament and broad vision, and they are interesting in their social intercourse with each other and with the strangers within their midst who are properly vouched for. And here, in a country that is a paradise of beauty, a wonderful people is pursuing its life, conscious of its worth, and with a world experience that compares favorably with the best of its continental confrères.

And what applies to Peru is equally true of Chile, Argentine, and Uruguay—similar experiences, similar conquests, similar European emigration, similar yearning for independence; fertile land, mountains that are filled with minerals, and climates that attract the lovers of life; these are the ingredients of a melting-pot that has evolved a new people in a new civilization that cannot longer remain unrevealed.

VIII. A DOUBLE CONQUEST OF PERU

From the Log, January 25. A day of rest after three strenuous days of business, pleasure, and interest in Peru. It is Sunday. The festivities are over and the guests have departed. It is in the small hours of the morning; the floors of the deserted halls are still covered with confetti; and the few guests remaining are talking over the triumphs of the party. Strenuous

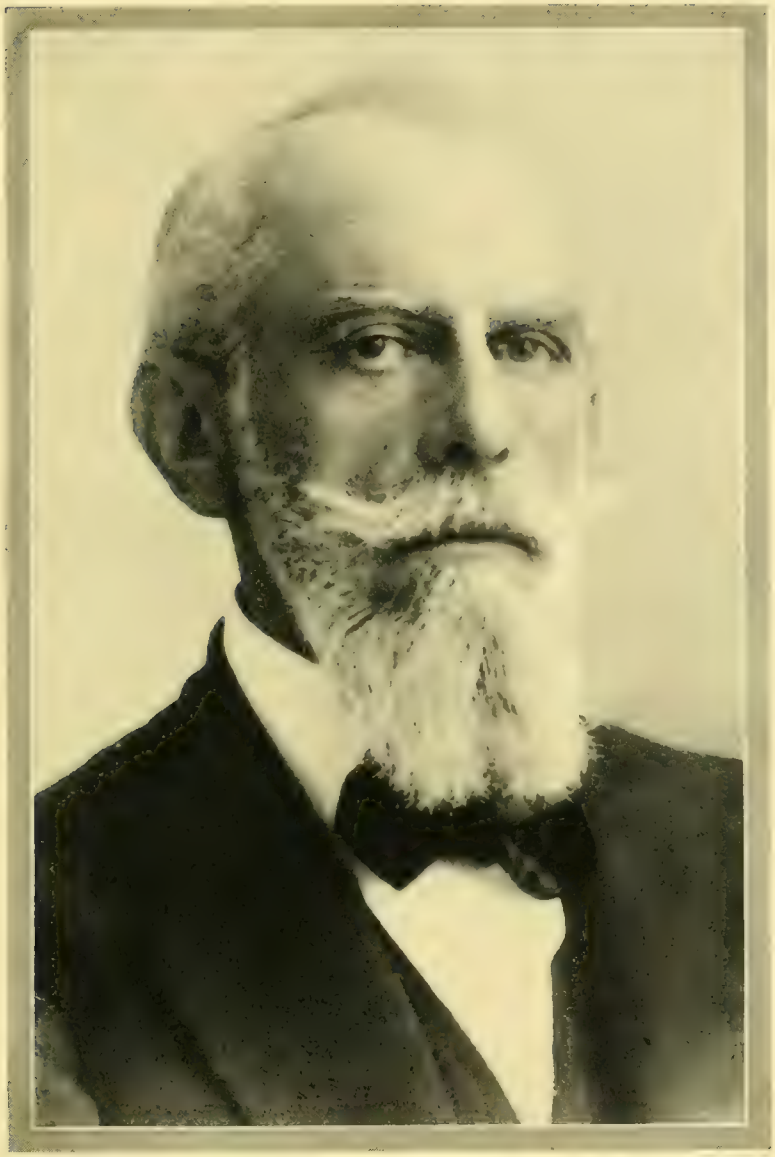
entertainment transpires so rapidly that one fails to grasp all of the thrills of it until he reviews it in retrospect. So with the visit to Peru. The three days spent there will become more and more interesting and important as time goes on. In talking it over, Dr. Mayo and I feel that we have been veritable Pizarros—Dr. Mayo the leader and the rest of us his lieutenants. We have brought down certain ideals and our object has been to reconquer Peru. Our victory is different from the old one in that those whom we came to conquer have outgeneraled their adversaries and conquered us.

And so Pizarro sits this Sunday morning under a white canopy on the deck of his flagship, surrounded by his faithful adherents, and enjoys a day of rest. The coast of the conquered continent is within sight, and over the rugged hills of the shore-line occasionally appear the snow-capped peaks of the second tier of mountains. We are just under the line of the sun on its excursion back from the Tropic of Capricorn, and the rays are perpendicular. But Pizarro and the conquering army care not because the Humboldt current with its cool water from the south pole has also brought a gentle, cooling breeze. So while the church bells in all parts of the world are calling the men and women to worship, and to observe their prosperous neighbors' apparel, we too take stock and give thanks for the wonderful new friendships we have made. But the chief, in his thirst for conquest, is drawing a new line on the map of the continent—a red mark which extends to Chile, Argentine, and Uruguay, and the ship turns its prow in that direction.

IX. DR. MARCELINO HERRERA VEGAS

Dr. Marcelino Herrera Vegas, who is easily the dean of surgery of the southern continent, is a man whom it is an exceptional honor to know. He has the face of a seer, and he possesses a sensitive, æsthetic temperament. He is of a family of distinguished Argentinians, the estate of which dates back to the foundation of the Republic. His town residence is a palace—the repository of works of art in painting, sculpture, literature, and the furnishings of a refined household. His library, with its gallery, is a cabinet of exquisite taste and appropriateness. With his own hands he has cross-indexed and catalogued the contents. The books, all his friends, are clothed in appropriate and substantial bindings, as he would dress his sons and daughters whom he loves. He writes with his own hand his literary contributions and gets recreation by making his own research. When his eyes and brain are tired, instead of playing games, he practices his languages and reviews his poets by writing plays in long-hand and by copying his favorite poems. He has twice written the plays of Shakespeare in long-hand to aid him in perfecting his English. To illustrate some point in conversation, he occasionally quotes to you a thought from an English, German, French, or Spanish poet, and then repeats the exact words with the interrogation: "Do you remember?" And, of course, as a rule you do not. Men of his class seem to have sufficient time in which to crystallize their knowledge, and they have a knack of utilizing their learning without appearing ostentatious. Dr. Vegas would rather know thoroughly the great thought of a master, in order that he might live it, than be the originator of something but little better than the commonplace. We, in rapid-fire America, must seem crude and immature in comparison with the associates of this man who reads his classics, and who has gained for himself a knowledge of the best of the ages. And with it all he is a practical teacher of surgery; he is a skilled operator; he endeavors to redeem the cripples and to save the lives of the poor of Argentine; he is a scientific man in the understanding of his art; he visits hospitals, dresses wounds, is a time-server, follows schedules, and consults time tables. When the summertime has come and he is through with his classes and the day's work is done, he does not employ his time in useless play, but goes to his *hacienda* and lives with the out-of-doors, the companions of his estate, and supervises the cultivation of the land. He watches trees grow that were planted by his grandfather, and he plants trees that will be watched and enjoyed by his grandchildren. This is our friend as we learned to know him—a superb character, a true gentleman, and one who is greatly admired by his confrères.

And this is the type that we met among the professional men of the cities of the four South American republics which we visited. We found a premium placed upon education, a knowledge of the languages, and experience gained in foreign travel. The cultivation of the finer graces is encouraged. The study of art, literature, and music of the highest quality is pursued, and a knowledge of the finer arts is considered essential to good breeding. I wish that all of our friends could know as we do these outstanding characteristics among their maturer men, who are so honored and looked up to by their younger followers and admirers—Gregorio Amunategui, Alberto Adriasola, and Lucas Sierra, of Chile; Marcelino Herrera Vegas, Daniel J. Cranwell,



DR. GREGORIO AMUNÁTEGUI

Professor of Clinical Surgery and Dean of the Faculty of Medicine, University of Chile, Santiago, Chile

and Pedro Chutro, of Argentine; A. Ricaldoni, Enrique Pouey, and Gerardo Arrizabalaga, of Uruguay; and Juvenal Denegri, Miguel C. Aljovin, and Guillermo Gastaneta, of Peru.

X. THE ROMANCE OF A DENTAL COLLEGE

February 13. An interesting diversion this morning was a visit to La Escuela Dental, the dental department of the University of Chile, at Santiago. The Dean, Dr. Jerman Valenzuela, was our host and conducted us through a modernly equipped dental school. This institution has accommodations for three hundred students. Each student has a complete equipment, including a dental chair, instrument cabinets, instruments, supplies, and a laboratory for conducting a scientific clinic in dentistry. The building covers an entire block and is two stories in height. It is comparatively new and splendid architecturally.

Attached to the founding of this department of the university is an interesting romance which involves the supposed murder of a German Consul; the burning of the legation; the mysterious disappearance of the janitor of the building, and of a large sum of money belonging to the Consul's country which had been taken from the safe. A search among the ruins revealed the body of a man, much disfigured, on which were found the shirt-studs, cuff-buttons, and other personal effects of the Consul. The Chilean Government was much humiliated by the atrocious murder, and proceeded to make amends for the tragedy in every possible way. The official received a magnificent burial, and the state vied with the municipality in doing honor befitting the station of the deceased and the country which he represented. During the inquest, Dr. Valenzuela, the dentist, requested the privilege of examining the jaw and teeth. He made careful notes of his findings. He discovered that the murdered man had splendid teeth without fillings or defects, and that one wisdom tooth was missing. He then consulted the wife of the Consul and learned that her husband had had defective teeth and had been the subject of considerable dental repair. The wife of the janitor stated that her husband had had perfect teeth and had consulted a dentist on but one occasion, when he had had a tooth extracted. This information, which confirmed Dr. Valenzuela's suspicion, was communicated to the proper authorities. The investigation that followed led to the capture of the official who had become snow-bound in the Andes in his attempt to escape with his bags of gold. He was brought back to Santiago, tried for the murder of the janitor and treachery to his government, and finally executed. In the meantime, the janitor had received a state funeral. He had been buried with great honor, and his remains placed in a mausoleum, as befitted the rank of an honored official of a great nation. The clearing of the mystery had relieved the Chilean Government of serious humiliation and embarrassment. Attention naturally turned to the unostentatious man who, by careful observation, had been instrumental in clearing up the international disgrace. What could the government do for him? He asked nothing for himself, but suggested that he had long possessed an ambition to build a model dental college for Chile. The Chilean Government asked him to present his plans, and the final result was the establishment of the thoroughly equipped institution that we visited today. We received a hearty welcome from this "Sherlock Holmes," Dr. Jerman Valenzuela, the Dean of La Escuela Dental, who has every reason to be proud of his ideal institution.

XI. A DEMONSTRATION OF EFFICIENCY

The pace for many days had been a fast one. On leaving the dental clinic in Santiago, Dr. Mayo, who is always considerate of his associates, intimated that I was looking rather peaked and suggested that I return to the hotel for a little rest, as our afternoon was to be a strenuous one. This, to me, was a welcome suggestion. The officials accompanying us suggested that they utilize my incapacity to give us a demonstration of their municipal service. The city has developed a personal service organization. Any individual in distress may, in case of injury or sudden illness, call for aid from any public telephone. An immediate response is accorded in the form of an auto ambulance, with a medical attendant. We were fully two miles from the hotel. I enthusiastically consented to become the victim for the experiment. A telephone call was made, and we were asked to time the response. In less than five minutes, considerable commotion was evident in the narrow street, and with a rush an attractive, clean ambulance landed at the curb. A white-coated official conducted me to the coach and placed me upon the couch. The ambulance turned and, working continuously a three-noted siren that could be heard for blocks and which all traffic is bound to respect, started for the hotel and arrived within the prescribed time—five minutes. It was a wild ride, because it was an official demonstration, and the importance of time on this occasion seemed to be thoroughly

appreciated by the attendants. However, we reached our destination without killing or maiming any people or dogs, and without catapulting any cathedrals or corner drug-stores.

The Chileans are a progressive and efficient nation, and this is obvious to the casual visitor. The Chilean Government, Army, Navy and Municipalities all reveal thorough organization, thrift, and administrative ability of the highest order. The little demonstration referred to above was a practical illustration of their attention to detail.

XII. OUR METHOD OF TRAVEL

It was difficult for us to make arrangements by which we could cover the necessary territory and return within the reasonable time limit of not to exceed two months. We, therefore, took advantage of a travel tour which was organized by the American Express Company, and the details of their plan were so generously carried out that we have not regretted traveling in that way rather than independently.

Our ship was the "Ebro" with an English crew and management. This eight thousand-ton, twin-screw steamer was built especially for cruising just before the outbreak of the war. It was thoroughly well-equipped for tropical travel, and possessed luxurious, modern conveniences.

ITINERARY

January 7, Wednesday — Sailed from New York.

January 13, Tuesday — Kingston, Jamaica.

January 16 and 17 — Panama Canal.

January 22, Thursday, to January 24, Saturday — Callao, the port for Lima, capital of Peru.

January 26, Monday — Mollendo, a typical Peruvian port.

January 27, Tuesday — Arica, a Chilean port, popular as a seaside resort. An excursion by rail to Tacna, the "oasis city."

January 28, Wednesday — Iquique.

January 29, Thursday — Antofagasta, the port through which most of the products of the Chilean nitrate fields are shipped.

January 31, Saturday — Coquimbo.

February 1, Sunday, to February 14, Saturday —Two weeks on shore with visits to Valparaiso, Santiago, thence by rail over the Andes to Buenos Aires, LaPlata, and Montevideo, on the east coast.

February 14, Saturday — Returned by rail to Valparaiso.

February 29, Sunday — Through the Panama Canal.

March 2, Tuesday — Another stop at Kingston.

March 8, Monday — Arrived New York.

XIII. OUR HOSTS OF SOUTH AMERICA

The Panama Canal has brought the western coast of South America—Lima, Valparaiso, etc. —within fourteen days of New York City, Chicago, or New Orleans. With a return to normal shipping conditions and a growing acquaintance with our South American people, a merchant marine, by mutual agreement, will soon develop that will make us the closest neighbors. And one needs to visit these countries but once to appreciate the great worth and charm of these neighbors.

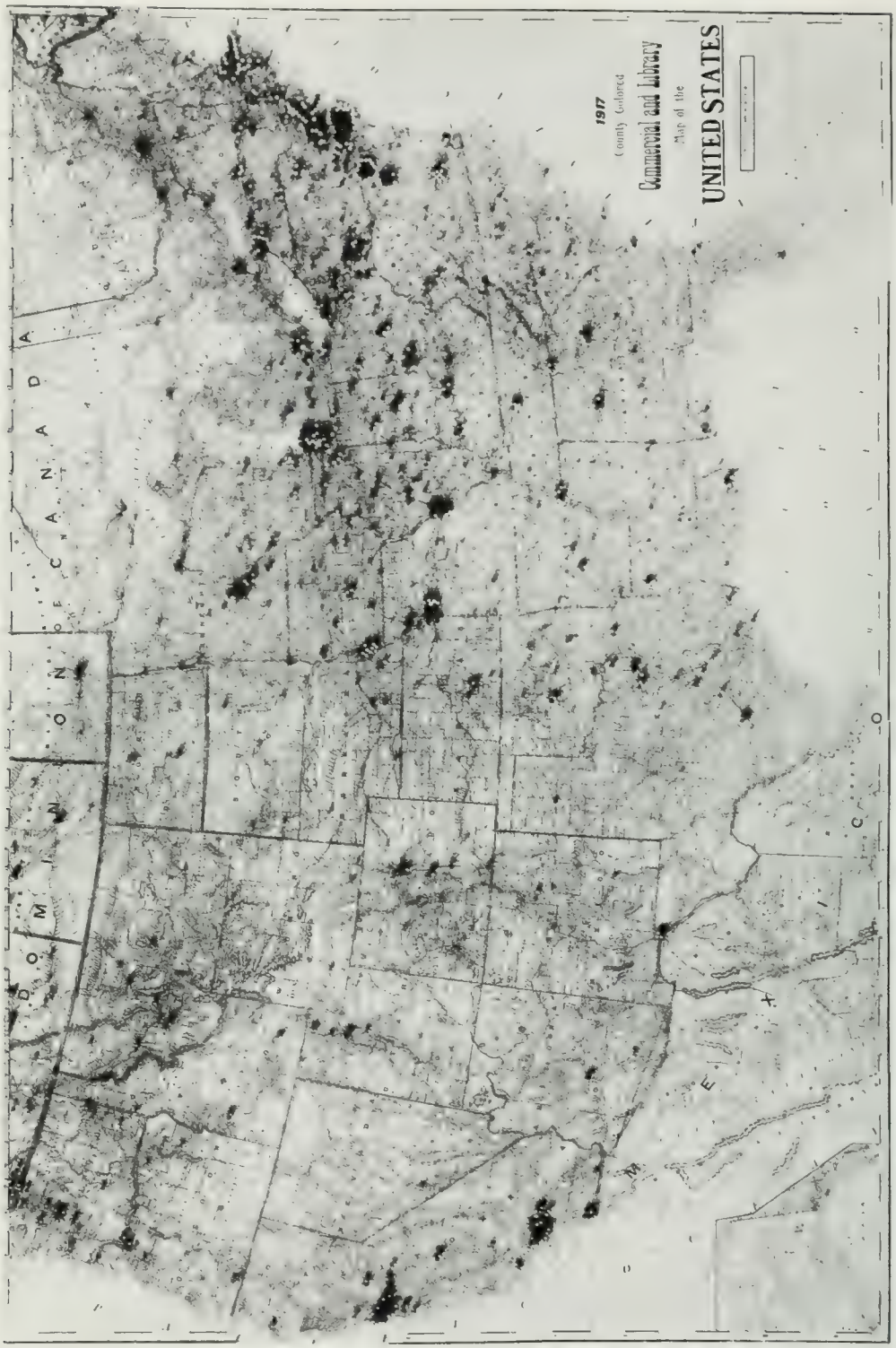
We were privileged to make our visit under exceptional circumstances. We were practically official guests; but in the busy times we had an opportunity of sitting at the home tables and getting an insight into South American family life. Everywhere we were charmed. The young men and women, the sons and daughters of our hosts, were interesting to study. In their education they are early trained in the arts, in the classics, and in the languages. The young women cultivate their music, and on a number of occasions we were thoroughly entertained by the daughters of the families playing with unusual skill the classics of Chopin, Liszt, and other composers with thorough ease and enjoyment. The young men are ambitious, and all of the young men and women have either spent a year or two in European travel, or are planning to do so. In their preparation for such travel, they have almost invariably learned English and French. And while in the past they have looked almost exclusively to Europe as their travel ground, they are now talking of America, and this spirit of friendliness and appreciation for the United States is materializing rapidly and nothing will develop their attitude more than visits by us to their countries. We must lay aside our provincial airs and cocksureness, and be willing to broaden out as they have done, learn their language as they have learned ours, and make ourselves worthy of a cosmopolitan friendship.

After visiting a few of these wonderful countries, the United States grows smaller in one's estimation, and the only way we can keep it big is to be willing to broaden out as citizens. Many representatives of the medical profession of South America will visit the United States in the next few months and years. Let us look to our laurels! Remember that they have hospitals

DR. JUVENAL DENEGRI

Professor of Otology, Rhinology and Laryngology, University of San Marcos, Lima, Peru; Surgeon to Santa Ana Hospital; President, Sociedad de Cirugía del Perú

which are equal to our best, and most of them are much more attractive. Remember that each of their principal countries has a national medical university as thoroughly equipped as are our own, with world-trained faculties, and a seven-year curriculum as compared with our four- and five-year courses. Remember that the man you are entertaining has not been satisfied with the advantages afforded by his own country, but that he has also observed the best in France and in Germany. Remember that you are associating with a man from a country where a classical education is the pre-requisite of a gentleman. The United States now has the opportunity to enter into competition with the countries of the world as a medical-educational center. There is but one way to make good, and that is to utilize our great resources to the fullest extent and to do it with the realization that we are only one of the many nations which possess unusual resources. If it is possible, let us cultivate modesty, and the best way to do that, and certainly a pleasant way, is to visit the medical profession of South America.



Map showing 1667 general hospitals of the United States and Canada included in survey of American College of Surgeons. The black dots indicate 671 institutions with a capacity of 100 or more beds. The white dots indicate 996 institutions with a capacity of 50 to 100 beds.

THE PROCESS OF HOSPITAL STANDARDIZATION

THE minimum standard of the College in its hospital program is now familiar to a majority of the physicians and surgeons of the continent and it is well known to practically every hospital superintendent. Further, doctors and superintendents know that the minimum standard is their own expression as to the first essentials in the right care of patients. The time of discussion has gone by and the time of action has arrived. Some details of this action, or of the process of standardization, may be of interest.

On the map appearing on the opposite page are 1667 black and white dots. These mark the general hospitals for the care of acute diseases in the United States and Canada. Each black dot represents a general hospital with a capacity of 100 or more beds, of which there are 671. Each white dot represents a hospital of from 50 to 100 beds, of which there are 996.

The program of the College for 1920 is, through its staff of visitors, to explain in detail to superintendents, staffs, and trustees of these hospitals what the minimum standard is, what the problems are which arise in connection with it, and what the practical solutions to these problems are as determined by experience among hospitals. Further, the visitors are to collect exact information as to the extent to which each hospital fulfills the standard. The visitor's record card as shown below illustrates the fashion in which this information is gathered. On the face of the card the visitor reports concerning staff meetings, case records, and laboratory service; on the reverse side of the card, concerning the number of deaths, autopsies, facilities for pathological work. General notes are also included.

At the present time there are seven visitors of the College—all men with medical education—at work in the field. One is now in Louisiana, one in South Carolina, one in New Jersey, another in Michigan, another in Ohio, still another in Oklahoma, and two in Canada. The number of field workers is to be increased. The work of the visitor is to be helpful and constructive. With this policy thoroughly understood, he starts on an itinerary planned some two months in advance. The hospitals are notified in advance of each visit. On visiting a hospital the man in the field mails a daily report to the central office. With

File No. 713

AMERICAN COLLEGE OF SURGEONS CHICAGO Date March 10, 1920

Visitor Dr. F. W. Slobe

Hospital ---------- Hospital. Capacity 100 (Soon 140) Internes 1

Address ----------, Virginia Type General Grad nurses 4

Superintendent ---------- R.N. Affiliation None Pupil nurses 29

I STAFF ORGANIZATION

1. Does staff meet at regular intervals? Yes
2. If so, how often? Each month
3. Does staff consider character of work relative to right care of patients? Only partially
4. Is the practice of "division of fees" permitted? No ruling

II. CASE RECORDS

	FREE	PAY	PRIVATE
Personal History	—	—	—
Physical Examination	—	—	—
Working Diagnosis	—	—	—
Laboratory Findings	+	+	+
Treatment or Operation	+	+	+
Progress Notes	—	—	—
Final Diagnosis	—	—	—
Condition on discharge	—	—	—

Notes Only nurse's notes, some laboratory reports, and operation sheet kept on floors. No filing system, records kept in boxes in basement.

Form D

III. CLINICAL LABORATORIES

	IN HOSPITAL	OUT OF HOSPITAL
Chemical	+	
Bacteriological	+	
Serological	+	
Histological	+	
Radiographic	+	
Fluroscopic	+	

Head Lab. Technician: Trained + Full-Time + Part-Time

X-Ray Lab. Technician: Trained + Full-Time + Part-Time

Records kept in lab.: Pathological — X-Ray Incomplete

Notes Full-time Xray and laboratory technicians; former working on percentage basis, and latter on salary - records of both inadequate. Laboratory crowded.

this daily report are enclosed cards with the information gathered at each of the hospitals. At the end of each week the visitor also sends to the College a letter which covers in minute detail the results of his week's effort. He reports especially suggestions of value which he has received, and he gives any information which in his opinion will make for the betterment of the work.

Busy superintendents, busy doctors, and busy trustees are cordial in their co-operation. As one doctor put the matter: "It is wise that we lead now in a program for the better care of patients rather than to be forced later by the public to follow in such a program."

The following extract taken from the instructions issued to each hospital visitor tells its own story:

"The visitor is to collect facts and he is to collect facts only with the good will and approval of the respective hospitals. His mission is business. He is not a detective, an unbidden critic, nor a social caller. He is not to make comparisons of one institution with another. He is to be helpful and constructive. The success of his visit will depend much upon his sincerity. He must *believe* in his work. The visitor who is unwelcome has in all probability not wisely handled the situation."

SURGERY, GYNECOLOGY AND OBSTETRICS

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JAUNDICE AND ITS SURGICAL SIGNIFICANCE[1]

BY C. H. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

JAUNDICE as a symptom of disease may present a very serious problem in tracing its cause. In approximately 50 per cent of the cases seen the absorption of bile is due to obstruction of the common duct by gall-stone; in 20 per cent of all cases it is due to absorption of bile in the liver, or infective or catarrhal jaundice without duct obstruction. Most of the latter cases occur in children and young persons, just enough occurring in middle age and later to make a differential diagnosis necessary, as attacks of pain sometimes accompany this infectious disease or the patients actually have gall bladder disease.

It is not my intention to discuss the diagnosis of the various causes of jaundice, but to consider the treatment of obstructive jaundice in cases in which the patient is on the table, the abdomen is open, and jaundice is either present, or the patient is having a free interval between recurring attacks. The surgeon must have in mind the fact that jaundice is an essential feature of several conditions, and that it is an indication of serious disease in the majority of cases. The idea that jaundice may be a symptom in fairly normal persons over long periods evidently came about from the observation of hæmolytic acholuric jaundice caused by splenomegaly, a surgically curable disease, sometimes complicated with gall-bladder disease and stones. From 5 to 8 per cent of the cases of jaundice are due to serious infection of the gall-bladder, possibly gangrene, with or without stones; they are usually accompanied by a degree of pancreatitis with marked swelling of the lymph glands on the three ducts; all persons have one on each duct, but no one more than two. The liver is congested and dark; the ducts are slightly enlarged and contain much flocculent material which is also found in the gall-bladder in which stones are usually present.

Jaundice from cancer presents a very serious problem, although it represents but 15 per cent of the cases seen; one-half of these are from cancer of the liver, the other half from cancer of the pancreas, or the gall-bladder, and ducts. Patients with cancer of the pancreas or in the ampulla of Vater may be relieved, often for many months, by short-circuiting the obstructed area. We have not had a permanent cure from transduodenal extirpation of tumor of the ampulla; and it must be admitted also that it is sometimes difficult positively to determine whether the hardening of the pancreas causing obstructive jaundice is of a malignant or of an inflammatory nature. Jaundice from cirrhosis, with ascites usually present, occurs in about 8 per cent of cases. The old classification made by Courvoisier still remains a true observation, in which in about 84 per cent of the cases of stone in the common duct the gall-bladder was shrunken or atrophied; while in 92 of 100 cases of obstruction due to

[1]Presented before the Western Surgical Society, Kansas City, Missouri, December, 1919.

lesions in the ampulla or pancreas or other conditions, the gall-bladder was dilated or enlarged; in the remaining 8 cases it was either normal or atrophic.

In cases of chronic jaundice with obstruction the distended gall-bladder and ducts are often filled with a clear mucoid fluid, indicating, I believe, that the power of the mucous gland to secrete the less absorbable mucus which fills the ducts is greater than the power of the liver to secrete bile, and forces the liver with its lower blood pressure to absorb the bile. In cases of late operation at which the so-called white bile is found, failure of the power of biliary excretion to appear within a day or two following the operative drainage is a most unfavorable symptom. Long continued jaundice slows the coagulation time of blood; as a rule if the coagulation time is under 10 minutes it is not of serious moment, but a 10 to 25 minute period is not uncommon, and in some cases the blood will not coagulate in an hour. Patients in whom the blood leaves the vessels as shown by numerous subcutaneous hæmorrhages should be medical cases until improvement occurs before surgery is indicated. Calcium has been given, with questionable relief, to reduce the delayed coagulation time of patients with chronic jaundice who are being prepared for operation. The best measure in cases with 12 minutes or more coagulation time is the transfusion of acceptable human blood. Patients whose coagulation time is greatly reduced are given one transfusion and the blood is tested the next day. If improvement is marked operation is performed, but if improvement is slight transfusion is repeated just preceding the operation, and, if there is hæmorrhage during the next few days transfusion is again repeated with occasional benefit.

If the gall-bladder shows marked evidence of disease, especially in cases of stone in the common duct, a cholecystectomy is performed. After removal of the gall-bladder the cystic duct is split through into the common duct to permit of an exploration; here the pliable metal spoons and bulb-tipped probes, and the Gusse fenestrated stone forceps of various sizes are useful. In the rare instances in which the gall-bladder has already been removed a more favorable location than the cystic duct area can be selected. In more severe infection with degrees of gangrene, the gall-bladder should be removed unless the serious condition of the patient makes haste imperative; then it is drained with or without drainage of the common duct, depending on whether or not bile flows from the gall-bladder.

In such cases the gall-bladder is split on each side with scissors from top to bottom, one-quarter of an inch from its attachment to the liver. The free flap is turned downward, exposing the obstructing stone in the cystic duct; the duct is clamped in forceps and divided. The mucous membrane remaining on the liver attachment readily peels off, leaving the outer layer of the gall-bladder for protection since if this should be peeled off serious hæmorrhage, difficult to control, may result. Suturing such a liver adds to the infective condition, for the liver structure does not permit of drawing sutures sufficiently tight to check serious hæmorrhage from its surface; this is one of the reasons why cholecystostomy has been made in some cases. A knowledge of the size of the various ducts is quite essential; in a healthy person the lumen of the cystic duct is about one-eighth of an inch and the lumen of the common duct about one-sixth of an inch. When it is only a little enlarged and with jaundice present infection is the essential factor. A gall-bladder which has been rendered functionless by nature, disease, or operation causes dilatation above the normal of the common and hepatic ducts. A serious and not uncommon cause of jaundice is the too radical extirpation of the gall-bladder and cystic duct and section of the common duct in cases in which jaundice was not a previous symptom, and in which the hepatic duct is mistakenly ligated for the cystic; primary jaundice and later a prolonged biliary fistula result, following which intermittent closure leads to intermittent jaundice. In such cases if the condition is not recognized immediately and very early union effected by means of a Sullivan T-tube the common duct undergoes atrophy and cannot be utilized again. The effort to secure delivery of bile from direct incision of the liver or by trocar, tapping a

dilated duct, is a last resort from which relief is only temporary, and if unsuccessful life is possibly shortened by free hæmorrhage.

Jaundice in which the head of the pancreas shows marked hardness, lobulation, and increase in size, requires most careful consideration. If the gall-bladder is distended the condition is due either to pancreatitis or to a malignant change, since the pancreas, as Opie has shown, surrounds the common duct in 32 per cent of persons sufficiently to make obstruction possible by pressure Obstruction from swelling at the tip of the ampulla may cause a pancreatitis by forcing bile through the major duct of Wirsung back into the pancreas and out of the duct of Santorini. The pancreas, in its development, is evidently prepared for such emergencies since all the ducts of the organ open into the lumen of the larger ducts by passing along its wall for some distance. The closure of the ducts is caused by tension, which is nature's method of protecting all important ducts, such as the salivary and common ducts, and the ureters near their exits, as was shown by Coffey.

A careful examination of the pancreas in all cases of gall-bladder disease or surgical gastric disease indicates that the pancreas is secondarily involved by infection following gall-bladder disease more frequently than has been supposed. When secondary infection of the pancreas is a marked feature of gall-bladder disease, it may be advisable to provide drainage from the common duct, but usually the gall-bladder may be looked on as a primary focus, and should be removed. In most of the simple obstructions due to stones in the common duct, effective drainage is established after removal of the stones by means of the Robson tube passed into the opening of the common duct and up into the hepatic duct. The tube is held by a fine catgut suture as it emerges through the common duct incision. The suture serves also to close the opening about the drain. In cases of obstruction associated with distention of the gall-bladder, short-circuiting is best done by attaching the gall-bladder, after it has been emptied, to the duodenum. An opening one-half inch in diameter is made in the fundus of the gall-bladder, the peritoneum is denuded

Fig. 1. (a) Sullivan tube for common duct drain; (b) buried tube (C. H. Mayo) for uniting hepatic duct to stomach or duodenum.

for about one-quarter of an inch from the opening; it is then passed for one-quarter of an inch, through an incision at a conveniently near point, into the lumen of the duodenum. Such openings prove more permanent than the margin-to-margin union of the opening in the gall-bladder to the opening in the duodenum. In some cases with elongated cystic duct the gall-bladder is removed down to its pelvis, and this is passed through an opening in the duodenum which is then sutured around the cystic duct (Fig. 1).

Probably the most desperate and difficult cases of jaundice to deal with are those which follow extirpation of the gall-bladder and unintentional division of the common duct. The distended hepatic duct is searched for, usually among the adhesions of from two to four previous operations, or the temporary discharging fistula leading to the hepatic duct is followed. In cases in which the end of the

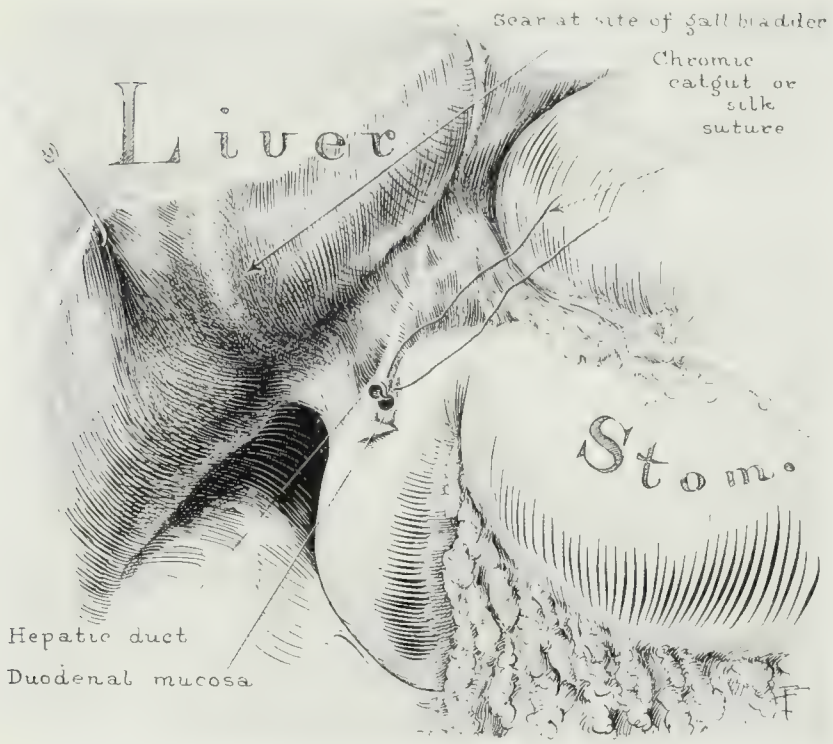

Fig. 2. Preparation for anastomosis of hepatic duct and duodenum.

hepatic duct is found opposite the duodenum or opposite the pyloric ring, the pylorus and duodenum are also mobilized and the union is made to the duodenum; this is the preferable method. Often the prepyloric region of the stomach is found adherent beside the opening of the duct. In such cases it is best to disturb the adhesions as little as possible and to anastomose the hepatic duct to the prepyloric portion of the stomach. To maintain this opening until nature contracts the tissues, developing firm union and a mucous-lined tube, it is only necessary to unite the end of the duct to the mucosa of the stomach or bowel (Fig. 2).

To facilitate this I have devised a drain which has proved most efficient and is made by cutting off the bell end of an ordinary male catheter, slipping two small rings cut from the next larger sized catheter over the smaller part of the tube, and gluing these rings with rubber cement. This little drain, varying in length from one and one half to two and one-fourth inches, is passed bell end upward into the hepatic duct, which has been loosened for a short distance. The catheter drain is sutured to the end of the hepatic duct and an opening is made into the bowel or stomach through which the lower end of the drain is passed, the lower ring catching in the wall of the bowel or stomach and the second ring just inside the end of the hepatic duct; the outer wall of the stomach or bowel is sutured around the end of the hepatic duct and protected by gastrohepatic or gastrocolic omentum adjusted around the anastomosis by sutures. The rings on the tube may hold it in place for as long as several months, or until the contraction has relaxed and the mucous membrane of the duct is united to the lumen of the bowel or stomach. In cases in which this union to the stomach is made all the bile passes into the stomach, but this is of no serious consequence and does not give any distressing symptoms (Fig. 3).

During the years 1916, 1917, and 1918, in 13

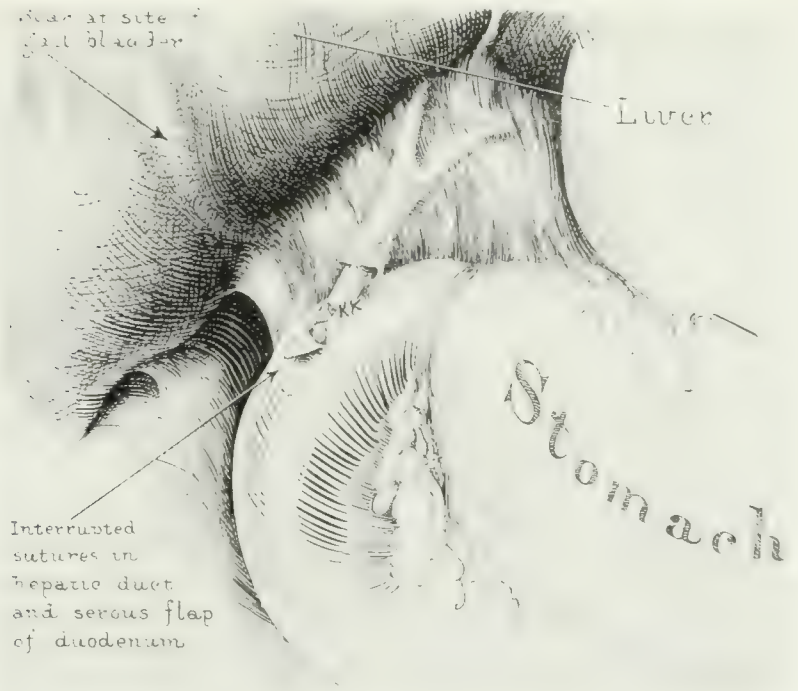

Fig. 3. Suturing partially completed; tube in place.

cases seen, it was necessary to unite the hepatic duct either to the duodenum or to the stomach; two of the patients died. Jaundice is a late symptom of gall-stone in the majority of cases, the result of neglect to recognize the condition or to advise operation in the preventive period. The mortality following cholecystectomy in the treatment of cholecystitis with or without stones is low, only 1.8 per cent in 2460 operations performed during the period of three years. There were 337 cases in which cholecystectomy and choledochotomy were both done, with a mortality of 3.2 per cent. In a group of 36 cases of very serious obstruction and malignancy, cholecystostomy and choledochotomy were done with a mortality of 16.6 per cent. Choledochotomy alone was done in a somewhat similar group of 47 cases, with a mortality of 15 per cent. If all the choledochotomies are grouped together, however, the mortality in the 420 cases is but 5.7 per cent, too high a mortality for simple cases of stone and obstruction, and too low for the late and complicated cases, including the cancers. Stones were found in the common duct in 274 of the 420 cases.

THE LATE TREATMENT OF GUNSHOT WOUNDS OF THE HEAD[1]

By H. H. KERR, M.D., C.M., F.A.C.S., Washington
Formerly Lieutenant-Colonel, M.C., U. S. A.

Of the vast amount of good that war surgery can contribute to civil surgery, there is perhaps nothing more striking than the results obtained in the treatment of head injuries complicated with paralysis. The cases with wounds of the skull involving the brain present two types of disability: one, from the skull defect, *per se*, and the one from the injury of the underlying tissue. Therefore, the treatment of these cases will be considered under two distinct heads, surgical and neurological.

Surgery can only repair the mechanical defect and its immediate results. All of the cases present to a greater or less degree the "defect syndrome." They are morose, retiring, and avoid their fellows. They suffer more or less from headache. Stooping over or turning suddenly will produce dizziness. Loud noises are extremely irritating. Exposure to the sun produces headache and prostration. Perhaps the fear of injury and knowledge of incomplete protection to their brains contribute to this characteristic train of symptoms. There is a definite disability from skull defect that is absolutely independent of any accompanying neurological lesions.

The defect syndrome can be improved or cured by the correction of the cranial defect. Various types of operations have been suggested; from the use of metal or other plates to osteoplasties of one kind or another. In the Neurosurgical Section at the Walter Reed General Hospital, we adopted the osteoperiosteal graft of Delangenière. We have modified it in two particulars. First, we prefer operation under local anæsthesia in the head-high position. This materially reduces hæmorrhage and lessens the bulge of the accompanying cerebral hernia. The patients stand the chiseling not only of the defect but in the cutting of the graft remarkably well. We have also changed the original technique in that we sew the graft to the pericranium with the bone surface inward. In this way we feel that the requirements of successful bone grafting are best obtained, i.e., a fresh autoplastic graft fixed in place with the bone of the graft in contact with living bone. The operation should be delayed for at least 3 months after healing. In cases with osteomyeletis of the skull, it is better to delay the bone graft to at least 6 months after healing of the wound.

The results have been eminently successful. No graft has failed to live and only one has not become solid within 4 months. In that case osteogenesis appears to be progressing

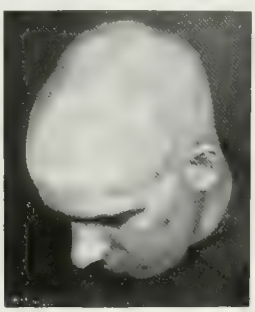

Fig. 1. Large cranial defect with spastic hemiplegia, repaired with osteoperiosteal graft taken from opposite side of head. Graft solid in 4 months.

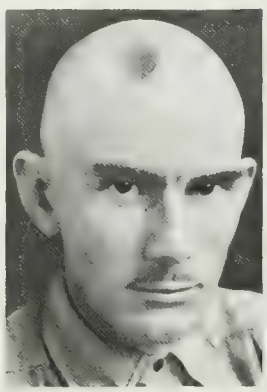

Fig. 2. Defect of frontal bone with extreme depression, repaired with osteoperiosteal graft taken from tibia.

[1] Read before the Southern Surgical Association, New Orleans, December, 1919.

Fig. 4. Operation, first step. Subglial injection of 1 per cent novocaine.

Fig. 5. Operation, second step. Exposure of bone defect and freshening edges with chisel.

from the periphery, and a successful, though depressed, correction is expected.

The effect on the patients is most encouraging. They become bright, active men, who resume their normal place among their fellow-soldiers and attack the problems of re-education with a hopeful vigor. Their dizziness is relieved. The headache disappears in the majority of cases. The graft protects them from the irritation of loud noises and the heat of the sun.

Although the question as to whether a skull defect should be repaired or not may still be debated, we feel from our personal experience that it is settled in favor of the repair.

As to the treatment of the neurological complications of gunshot wounds of the head we have followed the works of Shepherd Ivory Franz, scientific director, Government Hospital for the Insane. Dr. Franz has kindly visited our clinic and given us the benefit of his personal advice on many occasions

The first requirement in these cases is a thorough study by a competent neurologist. On the basis of his diagnosis the treatment is prescribed. In the cases of gross spastic paralysis, daily massage and splinting is instituted at first. The masseuse is instructed gradually to stretch each contracted muscle. The overstretched extensors are treated by massage and deep transverse percussion. The massage is accompanied by passive exercises with special attention to extension to overcome the continued flexion. Splints which overcorrect the contractions may be worn

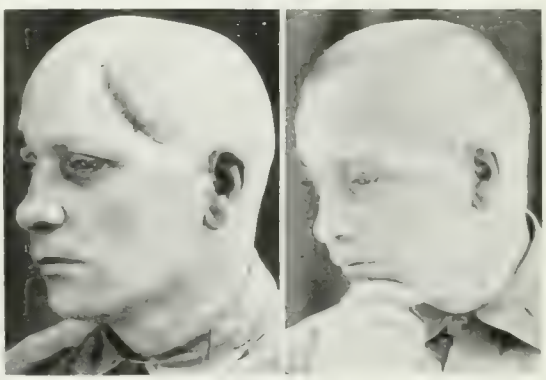

Fig. 3. Frontal defect repaired with osteoperiosteal graft.

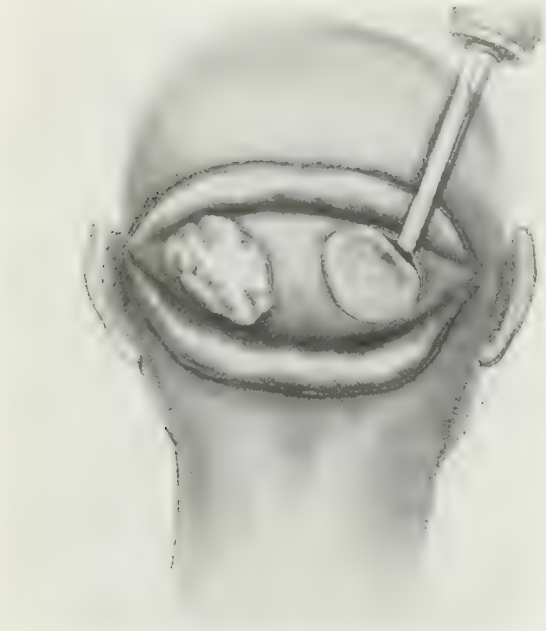

Fig. 6. Operation, third step. Linen pattern of defect cut and laid on neighboring pericranium as a guide to chiseling off osteoperiosteal graft.

Fig. 7. Operation, fourth step. Graft being sutured over defect bone surface inward.

intermittently. The massage and passive exercises are employed to make possible the voluntary use of the extensors in simple movement. In certain cases, voluntary movement could not be obtained for some weeks, but in all cases it was eventually brought about. At a very early date the patients are gotten out of bed and urged to walk. During this early period, a right angle stop splint has to be worn on the ankles to permit locomotion. Crutches and, later, canes are necessary, but their use is soon discouraged and the patient made to walk by himself, no matter how awkwardly or slowly he does it.

Fig. 8. Operation, fifth step. Closure of wound with 24 hour drainage.

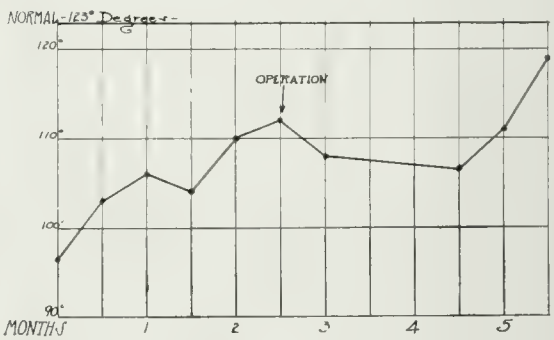

Chart 1. C. L., Gunshot wound of head. Hemiplegia. Chart shows dorsiflexion of left ankle.

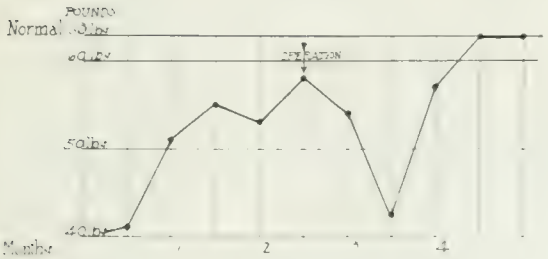

Chart 2. DeM., J. Gunshot wound of the head. Hemiplegia. Showing strength of right anterior deltoid.

Under such a régime the bed-ridden paralytics were soon up and around the wards. The cases were then given re-educative exercises of a competitive nature or in game form. Each movement must be considered in the light of its three components: its extent, its force, and its time. The exercises aim to produce, first, extent of motion; later, force; and finally, rapidity. When all three have been brought to normal an accurate motion has been produced.

Stepping over a string standard, kicking a basket-ball at a target, dropping a tennis ball into a basket are types of the exercises employed.

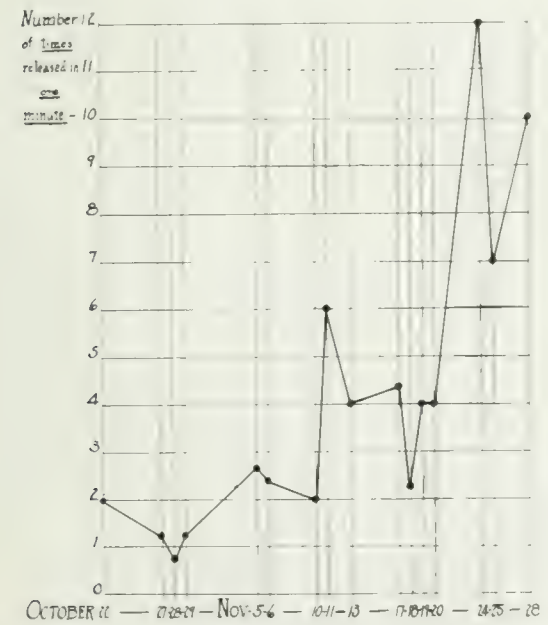

Chart 4. R., J. Gunshot wound of head. Hemiplegia. Chart shows the number of times ball was released in one minute.

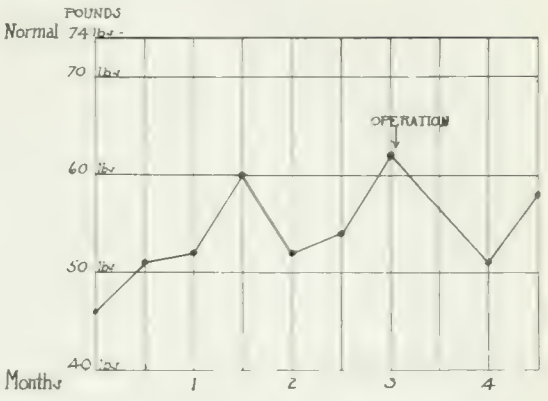

Chart 3. Same case as in Chart 1, showing flexion of right elbow.

The game idea and the sense of competition is made an integral part of the re-education. To this end scores are kept of the different exercises and games in which the patients take part. For instance, a man's ability to stretch his arm up the wall, or to release a tennis ball into a basket a certain number of times in a given time, is measured from day to day and compared to like efforts of his fellow-patients. A game of base-ball is played every day by all the patients together. It is most interesting to watch one of these games. No matter how awkward a motion may be performed under the stimulus of the game the patients somehow seem to be able to make hits and score runs, apparently forgetting their disability in the effort.

In addition to the scores of their exercises, each patient is measured as to his extent,

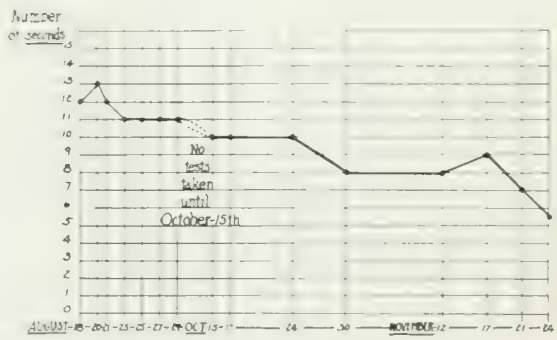

Chart 5. Same case as in Chart 4. Showing number of seconds consumed in running 20 meters.

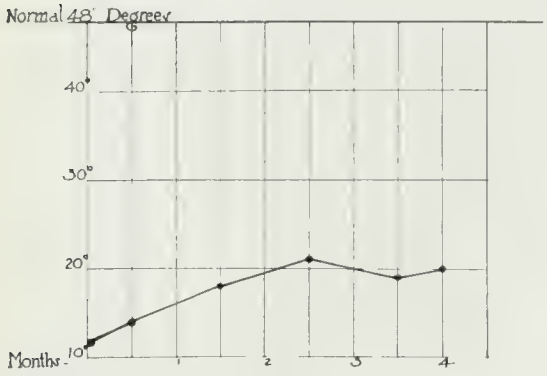

Chart 6. Same case as in Charts 4 and 5. Chart shows flexion of right knee.

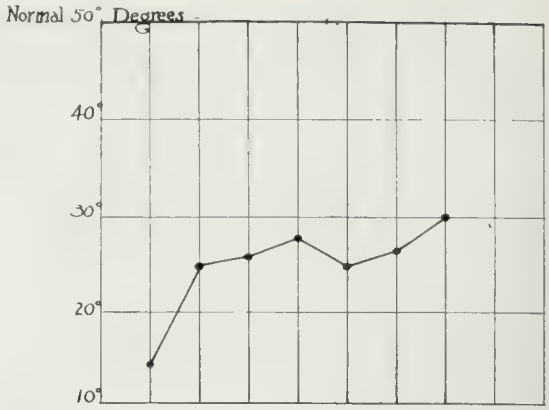

Chart 7. Same case as in Charts 4, 5 and 6, showing flexion of right elbow.

strength, and speed of movement at least once a fortnight. The results of these measurements are charted graphically and tacked to the wall where each patient may not only see his own progress, but the progress of his fellow patients. In addition to the moral stimulus that these charts give the patient himself, they are an invaluable guide to the therapy. Thus particular attention is paid to that movement which shows the least improvement. In this way, one group of muscles is brought back toward normal as soon as another, and substitution of movement does not occur. As improvement progresses exercises which educate the time and the accuracy of each movement are instituted. When the patient can grasp a pencil he is made to practice drawing a circle, then a square, and thus gradually is taught to write again.

Cases with gross defects and destruction of the motor cortex gradually acquire all the movements which they have lost. As Dr. Franz says: "We must therefore look on the different forms of cerebral paralysis as exaggerated difficulties of movement and not as inabilities to move. The facts show that the loss of certain function, because of cerebral destruction, does not indicate that the individual has not the function of capacity if suitable conditions of stimulation are provided." An experience with a large number of cases of cerebral paralysis most strikingly demonstrates that much more can be done for these cases than is commonly supposed. With proper appreciation of this fact we should be able to re-educate each case of traumatic cortical injury to a degree of practically no permanent disability.

CONGENITAL EQUINOVARUS

Report on 114 Cases[1]

By C. F. EIKENBARY, M.D., F.A.C.S., Spokane, Washington

In April, 1913, the writer gave a report in *Northwest Medicine* covering 36 cases of congenital equinovarus. Those 36 cases are included in this paper, together with 78 other cases. The number refers to the feet and not to the number of patients, since obviously each foot presents its own problem.

Twenty-two of the cases are still under treatment, the period of treatment varying from 2 to 6 months. Two of the cases operated upon within the past 6 months were of the exaggerated type, requiring a cuneiform resection. These two have been so recently operated upon that they are not included in this report.

Five of the 22 cases coming under our care during the last 6 months are being treated by the gradual process, that is, molding and plaster supports. Of these 5, 3 are entirely corrected but will have to continue with the plaster supports for at least 6 months longer. In 2 of the 5 cases, the period of treatment has not been long enough to effect a complete correction of the deformity.

Counting the 2 cured cases (Figs. 1, 2, 3, and 4) mentioned in the paragraph relative to the 22 cases still under treatment, we have a total of 94 cases on which we can make an active report.

Twelve cases were of the exaggerated type in adults or in children as old as 12, necessitating extensive cuneiform resection (Figs. 1, 3, 5, 6, 9, and 10). Two of these (Figs. 9 and 10) are still wearing casts. Figure 11 shows the condition of the feet after the removal of the first cast at the end of 4 weeks. The other 10 have been dismissed as cured. Figures 2, 4, 7, 8, and 11 show the condition of the cases after the cuneiform resection. Figure 5 shows a deformity in one little girl on whom a cuneiform resection was done. Note that in Figure 5 the view is from the back showing the feet pointing almost directly backward. Figure 7 is the same child, the picture having been taken 7 years later. Figure 8 is a brother to the girl just mentioned. His feet were of the same type as his sister's. Unfortunately the pictures taken of the brother were not good. Both of these cases were operated upon 7 years ago. The last time the writer saw the brother he was acting as a caddy on the golf course. He now writes that he has finished high school, can walk all day without tiring, and can take part in sports with other young

Fig. 1 (at left). Age 22. Severe type. Cuneiform resection.
Fig. 2. Same case after cuneiform resection.

Fig. 3 (at left). Age 12. Severe type. Cuneiform resection performed.
Fig. 4. Same case after resection.

[1] Read before the North Pacific Surgical Association December 12-13, 1917.

Fig. 5 (at left). Age 6. Posterior view. Note that the feet point almost directly backward. Cuneiform resection.
Fig. 6. Same as Figure 5.

Fig. 7 (at left). Same child as in Figures 5 and 6. After cuneiform resection.
Fig. 8. Brother of child shown in Figures 5 and 6. Had identical condition as sister.

men. Figure 1 is a picture of a plaster model, the patient being a girl 22 years old, with a deformity so exaggerated that all the weight was being borne on the outer side of the foot, as would be indicated by the large bursa. She was operated upon in June of this year and all supports were discarded in October. She can now wear ordinary shoes, walks with scarcely a limp, and can dance in a manner quite satisfactory to herself. Figures 3 and 4 show the foot of a boy 14 years old. In this case we see the same type of deformity with the same large bursa as shown in Figures 1, 5, 6, and 10. The foot in this case was exceedingly rigid. He was operated upon in July of this year and all supports were discarded in October. He wears an ordinary shoe and can walk with scarcely a limp. The other cases included in the group on whom a cuneiform resection was performed, are cured, the period of time varying from 4 to 8 years.

Twenty-five cases, including the 5 mentioned as still under treatment, have been treated by the gradual process of molding and plaster supports. Excluding the 5 cases still under treatment, all of these patients are cured, the length of time elapsing since the dismissal of cases varying from 2 years and 6 months to 12 years. Figure 12 shows one of these cases taken at the time of starting the treatment, the first molding having been given before the Spokane County Medical Association in the spring of 1908. Figure 13 shows the feet at the present time, approximately 12 years later, a result that is all that could be desired.

Seventy-seven cases have been treated by forcible correction, with or without tenotomy of the Achilles tendon. Fifteen of this group have been operated upon since the middle of June of this year and are, therefore, still wearing plaster casts. All of the 15 are now corrected, and we are now merely waiting for a sufficient time to elapse to effect a permanent cure. One case in this group had an attack of infantile paralysis shortly after being dismissed as cured. The muscles involved were those of the outer side of the foot, thus causing a complete relapse into the attitude of deformity. Shortly after this the writer went into the service, and the foot is still uncorrected. In one case the father became disgusted and took the case from under the writer's care, owing to the fact that he had been told that the foot should be entirely well within a year. The result in this case is unknown. One case went from under the writer's care about 6 months after the operation, and later came under the care of Harry Sherman, of San Francisco. The result in this case as shown in Figure 14 is quite perfect, and no one seeing the boy walk would suspect that the boy ever had a club-foot. One case disappeared one week after the operation and has not been seen since. One case died of scarlet fever before

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 9 (at left). Age 9. Severe type. Posterior view.
Fig. 10. Same case as Figure 9, anterior view.

Fig. 11. Same case as in Figures 9 and 10, after cuneiform resection.

the cure of the club foot could be effected. This leaves 57 cases, all of which have discarded all retentive apparatus, the period since discarding apparatus varying all the way from 31 months to 11 years. Six out of this group had very resistant feet and were never quite entirely overcorrected. Those 6 cases have only fair results. The feet can be dorsiflexed to a position at right angles to the leg, but cannot be brought above this point, a condition that is not conducive to a good foot. All of the 6 have a very slight degree of pigeon toe. However, the results in the 6 cases are such that the parents are well satisfied and prefer to leave the children as they are rather than to subject them to further operative measures. The results in the remaining 51 cases are all that could be desired. In all the cases the patients have good walking feet, all walk without limping, and none is pigeon toed. In all the cases no one would be able to tell that equinovarus formerly existed. Figure 15 shows one of these cases before the operation and Figure 16 shows the foot after operation, the second picture having been taken 4 months after the first. Note that the line of weight-bearing falls through the patella and through the crest of the tibia and the base of the second toe.

TREATMENT

There is no mystery surrounding the correction of a club-foot, nor are the surgical problems at all difficult. Some of the cases are quite resistant, some may relapse and have to be done over, some may require a cuneiform resection, but all of them may be given good walking feet. In spite of this, failures are quite common. Of the 114 cases embodied in this report, 60 had had previous operations or manipulations.

The writer considers that there are three reasons for failure:

1. The operator fails to grasp the fact that he is dealing with a triple deformity—equinus, varus, and adduction of the anterior part of the foot.
2. The deformity is not *over* corrected and frequently not even corrected.
3. The retentive apparatus is taken off too soon.

In considering treatment, it might be well to divide the cases into three headings: namely, mild or moderately severe cases in young babies; mild or moderately severe cases past 6 months of age; severe cases past the sixth year of life. Naturally the periods of time mentioned are merely suggestive. The extent of the deformity and the development of the individual should be the deciding factors.

MILD OR MODERATELY SEVERE CASES IN YOUNG BABIES—FIGURE 12

In this type the correction can easily be brought about by the gradual method. The foot is manipulated at intervals of from

Fig. 12 (at left). Ordinary type seen in infants.
Fig. 13. Same case as in Figure 12. After 11 years. Gradual correction by molding and plaster casts. No anæsthetic given at any time.

a week to 10 days, a plaster cast always being applied in the position of the *greatest correction*. The cast should extend above the flexed knee in order to prevent rotation, to relax the gastrocnemius, and also to prevent the child from kicking off the casts. Full correction may be brought about by this method in a month, it may take several months, and it may fail entirely, depending upon the resistance of the tissues and the skill of the operator. When full correction is obtained, the foot should be retained in a plaster support, usually for a year. Toward the latter months of treatment, it is the writer's custom to carry the cast merely to the calf line. In none of these procedures is an anæsthetic necessary.

MILD OR MODERATELY SEVERE CASES AFTER THE SIXTH MONTH

Here an anæsthetic is necessary. The procedure is the same as that described above except that the correction is made at one sitting.

The foot is manipulated until it is flabby, and the varus and the adduction of the anterior part of the foot can be readily overcorrected. The Achilles tendon is then divided subcutaneously and the equinus corrected. The writer has never found it necessary to divide any of the structure along the inner side of the foot. Here again the cast is carried above the flexed knee, and for the same reasons as given above. A year or more is usually required to remove all tendency to revert to the original deformity.

SEVERE CASES AFTER SIX YEARS OF AGE

By severe cases, the writer refers to the type as shown in Figures 1, 3, 5, 6, 9, and 10. Here a cuneiform resection gives perfectly satisfactory results and does so quickly. A wedge of bone, varying from a half inch to an inch and a half or wider is taken from the mid-tarsal region, the base of the wedge being along the outer border, the thickness of the wedge depending entirely upon the amount of deformity, enough bone being taken out easily to admit of complete correction. The wedge extends through the entire width of the bony structure of the foot. Two or three kangaroo stitches are passed through the two bony sides and the raw areas of bone securely sutured. The Achilles tendon is usually divided, although not always. Owing to the extensive work done, the length of time required to effect a cure is much shorter than with the more conservative method. Six months is usually sufficient time to bring about a complete cure, and in many instances the cure may be brought about in 3 or 4 months, as was the case in Figures 1 and 3. The operation is only suitable in the severe cases as in Figures 1, 3, 5, 6, 9, and 10.

As a final point in the cure of congenital equinovarus, the writer would like to empha-

Fig. 14.

Fig. 15.

Fig. 16.

Fig. 14. End-result of case that passed from the writer's care. Case finished by Harry Sherman, of San Francisco.
Fig. 15. Usual type. Treated by stretching and tenotomy of Achilles.
Fig. 16. Same case as in Figure 15. Case still wearing cast.

size the necessity of walking, that is, weight bearing in the correct position, as a part of the cure. For this reason in the case of young babies, where the correction may have been made within a few months time, the writer deems it necessary to keep these cases under his observation until they are walking. In cases where stretching and tenotomy are done, as well as in the cases where cuneiform resection is done, the writer insists upon walking in the casts at the earliest possible moment, thus materially helping in the adjustment of the structures of the foot to their new relations.

RESECTION OF DOUBLE KIDNEY

By FREDERICK C. HERRICK, M.D., F.A.C.S., Cleveland, Ohio

THE surgery of the congenitally deformed kidney forms a line of progress made possible by modern methods of urological diagnosis and the advance in surgical technique. This progress is evidenced by the tendency toward conservatism, which aims at removing the pathological condition only and leaving the normal tissue capable of functioning. This has necessarily been the practice in single organs of the body, but in paired organs such as the kidneys, the practice has too often been to sacrifice a diseased kidney when possibly repair or resection would have equally relieved the abnormal condition and have saved to the individual part of his margin of safety.

In kidneys with double pelves, one containing a calculus or being the seat of a hydronephrosis, this principle readily applies. Young and Davis (1) report calculus destruction of the upper pole of such a kidney with resection and saving of the lower pelvis and kidney tissue. This they report as the only fully reported case of resection of the diseased portion of a double kidney to be found in the literature. They give an excellent embryological survey of the subject.

Fig. 1. Roentgenogram showing double renal pelvis.

The following case of violent renal colic, hydronephrosis in the lower pelvis of a double kidney with successful resection is here reported.

The patient was a woman 18 years of age, referred because of attacks of violent pain extending from the right kidney region into the right fossa and down the right thigh anteriorly. The first attack occurred one year previous to consultation, when the patient vomited and was in bed for a week; there was no hæmaturia, no passage of calculi; her urinary frequency increased to two to three times a night. Since then she has been constantly aware of soreness in the right flank.

During the past 2 days these attacks have recurred. There have been no chills nor fever, no hæmaturia, no pyuria. There has been increased urinary frequency.

Physical examination showed a well developed, well nourished woman, free from other signs of disease or deformity. Respiration was costo-abdominal. There was no flank fullness nor tumor to be felt. The right kidney was palpable, descended to the second degree, was tender, and gross percussion over it in the flank posteriorly gave marked pain.

Cystoscopy at this time under difficult circumstances showed marked congestion, and bullous œdema around a right ureteral opening. The left opening was normal but small. Wax tipped catheters were passed up both ureters but showed no scratches.

The patient came to Cleveland and entered the hospital. An X-ray for stone was negative.

A second cystoscopic examination was made. The left ureteral opening was normal in appearance, contracted normally, and clear urine was coming from it. The right opening was in its normal posi-

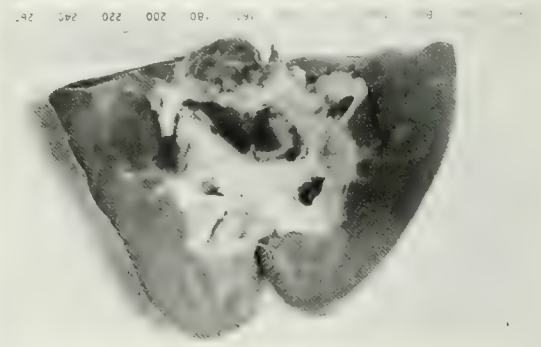

Fig. 2. Resected portion of kidney.

tion, slightly congested, with bullous œdema about it. About 3 millimeters above it was another opening, very small, tunnel-shaped, pale-colored, contractile. A functional test with a plugging catheter on the left side showed the left kidney secreting 25 per cent phthalein. The right side (from both ureters obtained by bladder catheterization) secreted 35.5 per cent. At another time with two catheters in the two right ureters the upper half (the lower ureteral orifice) secreted 12.5 per cent, the lower half (the upper ureteral orifice) 20.5 per cent, the left kidney 25 per cent. The urine from the lower pelvis contained a positive amount of albumin; that from the upper only a faint trace; neither contained pus nor casts. Pyelography showed a double pelvis on the right side. not connecting with each other, and two ureters passing separately. crossing, as usual, above the bladder (Fig. 1). In the X-ray it appears as though the lower ureter had a sharp kink just after leaving the pelvis. The lower pelvis showed its major and minor calyces dilated. The right double kidney therefore was doing more work than the left and the 25 per cent excretion of phthalein on the left is a fairly low amount upon which to rely after a nephrectomy of the opposite side. Add to this the fact that with a double kidney on one side the other side is likely to be a small kidney and working to its maximum. The urea nitrogen excretion from the two sides was as follows: the upper pelvis on the right excreted .053 grams of urea nitrogen per 100 cubic centimeters; the lower .065 grams; the left kidney secreting .142 grams of urea nitrogen per 100 cubic centimeters. Examination of the blood showed no retention of non-protein nitrogen containing 9 milligrams per 100 cubic centimeters.

Right-Upper 12.5 per cent phthalein .053 grams urea nitrogen.
Lower 20.5 per cent phthalein .065 grams urea nitrogen.
Left-Upper 33 per cent phthalein .118 grams urea nitrogen.
Lower 25 per cent phthalein .152 grams urea nitrogen.

A diagnosis was, therefore, made of a double kidney on the right side, the lower pelvis of which was hydronephrotic, and was causing attacks of pain. It was further evident that it would be best to save the upper half of the right kidney if possible. After removal of the lower half of the right kidney, represented by its 20.5 per cent phthalein excretion the total phthalein output after operation would be 37.5 per cent.

Operation, November 11, 1916. The right renal incision from the tip of the twelfth rib obliquely, intermuscular. The kidney was delivered and found large with a very slight sulcus corresponding to the apparent separation of the two pelves. The lower pelvis was well dilated. The vessels to the lower half of the kidney passed dorsally to the ureter and could not have obstructed it. A resection of the kidney was performed by a circular incision extending obliquely upward, removing the lower half together with its hydronephrotic sac. The incision was made oblique with the intention of more easily closing the cut surface. The intracapsular tension, however, was sufficient to cause the renal parenchyma of the upper half to bulge down entirely obliterating this wedge-shaped depression. Four mattress sutures were placed entirely controlling the hæmorrhage. The lower ureter was then divided between clamps, cauterized, and ligated.

The uncovered parenchymatous surface was now carefully covered with Gerota's fatty capsule stitched to it with No. 1 gut. The kidney was allowed to drop back into its fossa. A tell-tale drain of gauze was placed for 48 hours.

Recovery was uneventful. On the fourth day a slight discharge of urine occurred from the lower angle of the wound, where the gauze had been, but this stopped permanently after 2 days.

October 20, 1919, three years after operation, the patient has had no further symptoms, has borne a child normally, and is in perfect health.

Chronological review of cases of resection of double kidney found reported.

Case 1. Reported by Rumpel (2), in 1914. Male, age 36. Nephrolithiasis and partial hydronephrosis, with double formation of the renal pelvis. Resection of the hydronephrotic half.

Ten years before consultation the patient had bladder trouble. Two weeks before consultation he had recurrent attack with colic-like pains in the left flank. associated with bloody urine. Following this the patient had day chills and a rise in temperature to 39°.

Cystoscopy showed four ureteral openings, symmetrically arranged. All openings were slit-like and small. and there was no evidence of inflammatory reaction except in the left upper one, which was surrounded by a reddish area, with œdema. Indigocarmine appeared strongly through all openings except the upper left. X-ray showed a large kidney, with three stones in the lower part. Collargol injection showed a marked dilatation of the lower pelvis.

Operation. A large, fœtally lobulated kidney was freed from its fatty capsule, with difficulty. A number of large cysts was present on the convex surface. The lower pelvis and ureter were markedly dilated. Division of the lower hydronephrotic part of the kidney was accomplished after digital compression of the vessels and simple resection. The kidney stump was sutured. Drainage was used.

The specimen showed largely dilated calyces, three small calculi, and a very narrow edge of renal parenchyma. A urinary fistula resulted and was present to a slight degree at the time of report.

Case 2. Reported by Rumpel in 1914. Male, age 35. Partial hydronephrosis with double formation of the pelvis. The patient has had increased frequency of urination for the 5 years previous to consultation. He was treated for stricture of the urethra by the passage of sounds 2 months previously.

Cystoscopy. Because of intense cystitis and the large amount of pus present, the ureteral openings could not be recognized. A perinephritic abscess developed, which was drained and healed.

A second cystoscopy was done 6 weeks later. Four ureteral openings were recognized: on the right side, two close together; on the left side two about 2 centimeters apart. The left upper opening was dilated and gaping. All four openings discharged urine independently of each other. Indigocarmine appeared from all openings except the upper left. Pyelography showed a largely dilated lower left pelvis presumably of the mechanical type.

Operation showed a very large kidney, the upper half apparently normal, the lower half resembling a round tumor the size of a small fist, clearly cystic in type, and a bluish gray in color. The kidney was delivered with difficulty. A strong catgut thread, by means of a Ferguson needle, was placed around the entire circumference at the point of apparent division between the normal and hydronephrotic renal pelves. A clamp was placed on the lower half, the tissues were divided between the two, as also the ureter between clamp and ligature. Hæmorrhage was controlled by two deep sutures through the parenchyma of the sound tissue. In dividing the ureter, the normal ureter of the upper pelvis was accidentally cut. Because of its thinness and the difficulties attendant thereon, it was not implanted in its pelvis and was ligated. The ureter belonging to the lower pelvis, which was removed, was implanted in the upper pelvis, as it was thicker. The kidney was replaced. The wound was closed with rubber drainage.

The specimen showed a greatly dilated pelvis with scarcely any renal tissue visible. A urinary fistula was present at the time of writing.

Case 3. Reported by Young and Davis (1). Male, age 57 years, operated upon April 14, 1916. The patient had complained of pain in the left flank, of a dull, aching character, of 10 years' duration. with acute exacerbations. No renal colic. Urinary frequency moderately increased. An X-ray showed a large branched calculus in the upper pelvis and pyelography showed two pelves, the lower slightly smaller and its calyces normal. The upper showed its calyces markedly dilated. The ureters from the two pelves united 9 centimeters below the lower pelvis, on level with third lumbar vertebra.

Operation, April 14, 1916. showed the upper pole markedly adherent and calculi were felt. There was a distinct furrow between the two parts of the kidney. The pedicle to the upper pelvis was ligated and divided, and a transverse incision was made between the two segments just above the line of demarkation. Four mattress sutures controlled the bleeding from cut surface of lower half. The edges were approximated by pressure. Closure with drainage.

The specimen showed a mere thin-walled sac of fibrous tissue with entire absence of kidney tubules. A large branched calculus almost entirely filled the sac.

A urinary fistula developed on the thirty-fourth day but persisted for only 2 weeks.

Thorium pyelography before discharge showed a small left pelvis. Phthalein appeared, from the left side 3 per cent and from the right side 15 per cent.

Four months after operation the urine from both sides was normal and the phthalein output was 20 per cent from the right side and 5 per cent from the left side.

Case 4. Reported by Herrick. Operated upon November 11, 1916.

Case 5. Reported by Mayo (3). He says "renal stones were found in two patients with duplication of the renal pelves. In both, the caudal pelvis was involved; in one, a pelviolithotomy sufficed, but in the other a resection of the upper half of the kidney was necessary."

REMARKS ON DIAGNOSIS

In the diagnosis of surgical disease of the kidney, the frequency of congenital deformity must always be kept in mind, as well as the difficulty of finding supernumerary ureteral openings. These may vary in size, being larger than the normal, or smaller, to complete atresia; may have a normal shape and sphincteric action, or follow the several variations of the usual diseased ureteral orifices. They may be placed in the bladder, vagina, rectum, or perineum.

I recently removed a hydronephrosis in which the atretic ureter was attached to the rectum, was tremendously dilated and tense, and formed a teat-like process an inch and a half long, projecting into the rectum. This teat-like projection was felt *per rectum* during the general physical examination. There was no impulse in it on coughing, although it was quite tense, which ruled out hernia. It could be invaginated like the finger of a glove. It was not inflammatory, nor the result of trauma. It was, therefore, considered as a congenital deformity, though the exact nature of it was not surmised until at operation.

At operation an immensely distended left ureter and renal pelvis were found, and the ureter was 2 inches in diameter. The renal pelvis and ureter held 500 cubic centimeters of watery, slightly cloudy-looking fluid.

In the perineum ureteral openings are suspected when the patient is unable to keep him or herself dry, and there is no history of vaginal trauma, although there may be perfect control of bladder urine. In such cases

the folds of the urethral sphincter or the vaginal labia are especially difficult in which to locate an opening. The injection of a dye substance may be of assistance. Within the bladder they are located upon or in the close neighborhood of the trigonal borders. A close grouping of blood vessels may attract attention and surround the orifice. The bladder sphincter has been noted as a possible location. Weigert's rule, although exceptions to it are recorded by Braasch (4), must be remembered, i.e., that the distal opening drains the proximal kidney pelvis.

FREQUENCY OF RENAL ANOMALIES AND THEIR TENDENCY TO DISEASE

Glénard (5), in 1905, collected 527 cases in the literature. Dorland (6), in 1910, collected 121 in the following groups:

	Percentage
Horseshoe kidney	29.2
Absence of one kidney	19.5
Rudimentary kidney on one side	9.6
Displaced kidneys, one or both pelvic and one normal	16.9
Supernumerary kidneys	4.0
One-sided double kidney not fused	3.2

Malformation predisposes to disease. Young and Davis (1) quote (51,504) a large series of autopsies with one horseshoe kidney in 715 subjects, while in 1,000 kidney operations they found the same condition in the proportion of 1 to 143 subjects. Again, Robinson reports 50 cases of double ureter showing hydro-ureter in 24 per cent. In double kidney the pathological process occurs in the upper part in 79 per cent (19 of 24 cases). In the above case, as is more likely in hydronephrosis, the disease was in the lower pelvis. Rumpel's second case was of this kind.

RÉSUMÉ

1. Resection of a diseased double kidney or the diseased portion of a single kidney may be advisable in order to save a necessary amount of kidney substance for the individual

2. The resected end surface should be covered with fatty capsule.

3. I am able to find in the literature four other reported cases of resection of double kidneys.

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BLOOD-VESSEL SURGERY IN THE WAR[1]

By BERTRAM M. BERNHEIM, M.D., Baltimore

OPPORTUNITIES for carrying out the more modern procedures for the repair or reconstruction of damaged blood-vessels were conspicuous by their absence during the recent military activities in France. Not that blood-vessels were immune from injury; not that gaping arteries and veins and vicariously united vessels did not cry out for relief by fine suture or anastomosis. They did, most eloquently, and in great numbers, but he would have been a foolhardy man who would have essayed sutures of arterial or venous trunks in the presence of such infections as were the rule in practically all the battle-wounded.

Pressure of work, of course, had a deterring effect on fine work of any and all character—especially during the great battles where all refinements were cast to the winds in the general effort to save life. But quite aside from this, the blood-vessel suture had no place in the work of salvation. There were times and there were places where the stress was not so burdensome. And the equipment as regards fine suture material and delicate instruments was in hand, to say nothing of certain surgeons whose pre-war experience might well have permitted them to negotiate the work successfully—other things being equal. But, even in the casualty clearing stations and the small advance hospitals for seriously wounded, conditions were unpropitious. The risk was too great—the risk of secondary hæmorrhage following the breaking down of the suture by infection; for, whereas it was possible in a great proportion of the cases to do successful primary closure after careful *débridement* of wounds only 4 to 12 hours old, repair of damaged arterial and venous trunks could not be included in the list of cases amenable to such treatment. And this was true for the very good reason that, while certain low-grade infections were overcome in properly excised wounds and the more virulent infections resulted merely in complete opening up and drainage of such wounds, neither the one nor the other could have been tolerated in the presence of a blood-vessel suture. Disaster would have come about in either event.

There were exceptions, to be sure. Certain isolated successes will be reported without a doubt. But the teachings of Carrel together with the laboratory experiences of his followers had so effectually demonstrated the futility of attempting blood-vessel suture in any but a non-infected field that it needed but a glance at the type of wounds to be dealt with to realize from the outset the hopelessness of the finer blood-vessel surgery.

Excision and ligation were the rule. This was rather distressing, too, in many instances, particularly when only the side of a vessel had been injured or when the continuity could have been re-established by a simple end-to-end suture with or without a venous transplant. It required a high order of self-restraint to forego some of these cases—for there were many.

But after all, our knowledge of the incidence of gangrene subsequent to ligation of arterial or venous trunks of the extremities is unfortunately not profound. And it was this fact as much as anything else that influenced one toward the conservative and at least life-saving ligation. For even if gangrene did supervene, amputation was in most instances about the worst thing to be feared—an eventuality by no means as fraught with danger to life as a furious secondary hæmorrhage following an unsuccessful attempt at suture. For most of the men with injured great blood-vessels had already bled considerably and further loss of blood that was preventible was not to be considered.

So with simple ligation the rule in practically every instance of blood-vessel injury, small or large, the comparatively small number of cases of gangrene that resulted from this practice was to me little short of a revelation, that is, as concerns ligation of the femoral and axillary vessels. It may be

[1]The observations upon which this paper is based were made at advance hospitals for the seriously wounded, at evacuation hospitals, and at base hospitals, the period of observation being nearly two years.

that the youth and wonderful physical condition of the patients had something to do with the matter, although it has been commonly supposed that an adequate collateral circulation takes considerable time for its development in most instances. Hence it is usually seen in its highest development in those slow-going circulatory disturbances of the extremities so commonly seen in the aged, or near-aged. Possibly a more rational explanation is that as the vein is usually injured simultaneously with the artery, ligation of both artery and vein occurs at the same time. Thus though the inflow of blood is decidedly deranged, its outflow is definitely impeded. In other words, the most possible is made out of what little blood that does get to the affected part because it is held there longer than usual; for I think it is now rather generally agreed that if an arterial trunk is torn or injured, it is wise to impede the outflow of blood by ligating its accompanying vein even though uninjured.

There was a definitely higher percentage of gangrene following injury and ligation of the popliteal and brachial vessels, but that was to be expected, since the closer one approaches the terminal vessels the more gangrene does one encounter. Even so, in most cases there were complicating factors such as gas bacillus infection that obscured matters, but whether this was *post hoc* or *propter hoc* can not be said with certainty. Greater or lesser degrees of ischæmia, however, were not uncommon among the cases that escaped actual gangrene, resulting in severe atrophies and contractures of a more or less crippling nature. Even so an arm or leg of such type, unless too badly damaged, is better than none. I call to mind that case done in Base Hospital No. 18 by Dr. George Heuer—an aneurism of the axillary artery, the tissues all about being pus-infiltrated. Excision and ligation was followed by a marked atrophy and sensory disturbances of the whole arm, but enough function remained to warrant retention of the member. An arteriovenous aneurism of the popliteal vessels in which I practiced a similar operative procedure gave rise to a somewhat shrivelled leg, but the patient was able to walk and that was most satisfactory under the circumstances. That was an interesting case, too. A pistol bullet had passed through the knee-joint doing little damage to the bones. No operation was done and, as in many cases of this nature, the joint remained uninfected. But ten days after the injury the aneurism suddenly became apparent and at operation it was found that the bullet had just nipped both popliteal vessels. Even so, the vessels might have done no more than leak into each other had their immediate area not become infected. This was an instance then of a major joint being able to withstand an infection while the tissues surrounding blood-vessels succumbed to infection. It further illustrates quite well the point I have been making that vascular anastomoses whether made by suture or by a missile will hold only if there is no infection. In the case just cited, had the field remained sterile a typical arteriovenous aneurism would have remained and gradually developed. Some months or some years later, whenever it gave trouble, a reconstructive operation might have been successfully accomplished.

We had two other cases of this type—arteriovenous aneurism of the popliteal vessels—in the hospital at the same time as the one just mentioned. And in these, too, ligation of both artery and vein was practiced. One of them developed a gas bacillus infection which spread so rapidly that a mid-thigh amputation had to be done in order to save the man's life, while the other one came through with a fairly useful leg. This was an extremely interesting case. The patient, having had his primary operation elsewhere, came in with what looked to be an ordinary dirty wound of the popliteal space. After the most painstaking work, Dr. George Dunn, who had the case in charge, finally got the wound in shape for a secondary suture and was actually engaged in carrying this out when there was a sudden, furious gush of blood that was only controlled by tampon and later by a tourniquet. Investigation revealed the damaged vessels. It might be felt by some that in a case like this where bacterial counts had been made and the situation so controlled as to

permit of the wound's suture, conservative measures with regard to the blood-vessels should have been instituted. I can only say that secondary sutures are by no means certain even where conditions have been most accurately gauged, and I rather felt that the chances were against a successful suture. That my surmise was correct was evidenced by the fact that the wound under consideration broke down. It is conceivable, though, that with the circulation re-established and the surrounding tissues better nourished, primary healing might have ensued.

I have stated that blood-vessel injuries were quite common. That they were not of far more frequent occurrence was always a source of amazement to me. I have seen arms and legs, the bones of which were frightfully shattered by bullets or high explosive fragments, some penetrating, others through-and-through, leaving huge gaping wounds. Yet the blood-vessels were untouched. This remarkable phenomenon is surely referable to the inherent elasticity of the vessels by means of which they were enabled to avoid injury. The explosive force of the impact must just have forced them out of the missile path. Sometimes, though, where they were caught, crushed, and torn with the bone fragments, the wound of entrance was small and where there was no wound of egress, or a very small one, there ensued a muscle infiltrating hæmorrhage of such extent that frequently a whole thigh became one huge, tense, blue-black hæmatoma — all most conducive to gas bacillus infection. Such cases were best handled by immediate amputation at or above the seat of injury, since the ischæmia consequent upon ligation, the radical *débridement* that perforce had to be done, together with the severe bone injury could have but one result—a fulminating gas bacillus infection and gangrene.

I personally saw no injury to the carotid arteries—probably for the reason that practically all of them were immediately fatal. I did see a machine gun bullet lodged flush up against the jugular vein, but its removal was attended with no difficulty or after-effects, the vessel being intact! Injury to the vessels at the elbow were occasionally seen, but curiously enough they were rarely just at the bifurcation of the brachial artery and so, unless the bony condition necessitated amputation, *débridement* of the wound with ligation of the affected vessel sufficed. But there was one vessel whose injury always gave trouble—the peroneal artery. And it was remarkable how frequently we came across it. Three in one afternoon do I recall and in all three the ends were extremely difficult to catch and tie, due of course to the position of the vessel and its pronounced ability to retract when severed. I have heard it stated that injury to this vessel with the great amount of trauma incident to its capture almost always eventuated in gas bacillus infection with amputation later on. This is certainly a most pessimistic exaggeration. Careful *débridement*, ligation, and leaving the wound wide open gave good results in all our cases.

Of course, thrombus formation in the injured vessels was the great life-saver, but this very feature made it most imperative to search carefully the condition of the vessels exposed in wounds of great extent, especially where the vessel continuity had not been interrupted. I shall never forget that case where an assistant called my attention to a slight lateral bulge of a throbbing femoral artery, his impression being that the vessel wall had been crushed a bit and that an aneurism was in process of development. My suggestion that he hold the vessel between his fingers and then gently stroke the site of the bulge with dry gauze revealed a tear with an occluding thrombus. Ligation above and below was done with no ill effects. We saw a number of cases of this nature.

The foregoing statements will probably seem rather strange to those who were not fortunate enough to go abroad. Not having had any previous war experience, I was surprised myself. I will even confess to having taken over with me blood-vessel silk, needles, liquid vaseline, in fact all the delicate armamentarium that went with my work at home. But it was no use. There was no place for surgery of this type. During battles the efforts of all surgeons must be concentrated along the lines of saving life, with the point

always in view of the greatest good to the greatest number. After battles, efforts must be concentrated on cleaning up infections and doing reconstructive work. Blood-vessel surgery may have its place in the reconstructive work, perhaps, but I am rather of the impression that most of it will be done in the years to come when aneurisms of various sorts will begin to crop up, the aftermath of vessels wounded in France in youth but able to hold their own and carry on until age and perhaps hard work cause trouble in the weak spot.

TUBERCULOSIS OF THE BREAST

By EUGENE P. HAMILTON, M.D., Kansas City, Missouri

MRS. S. B., age 44; weight 125 pounds; height 5 feet, 8 inches; widow. The family history was negative except that her husband died of tuberculous laryngitis 8 years ago. As a child the patient was never robust. She had had scarlet fever, whooping cough, and diphtheria; also had a pulmonary tuberculosis 5 years ago, the sputum being reported positive for tubercle bacilli by the state bacteriologist. The patient says that her principal complaint at this time was nausea and extreme weakness. During this illness she was under the care of W. J. Marsh, of Tipton, Missouri, who gave her Koch's old tuberculin and had her live out of doors for about 6 months. Her condition rapidly improved and she has had no symptoms since that time. The patient entered St. Joseph Hospital, March 20, 1918, complaining of a slight soreness in her right breast and gave this history as its origin. Three weeks ago, while turning in bed one night, she bruised her breast on the mattress. It became tender and the patient noticed for the first time a hard lump. She consulted Dr. Marsh who found that the patient had a small tumor of the breast, but it was not tender nor was there any redness of the skin. On account of the patient's insisting that her trouble dated back to the supposed injury, she was advised to use hot alcohol packs to clear up the question of a traumatic mastitis. Marked redness of the skin soon developed, and it was the opinion of the attending physician that it was possibly due to the carbolic acid that was used in the alcohol.

Upon entering St. Joseph Hospital the patient was put to bed and was under observation for 10 days. During this time there was no temperature, and the blood and urine examinations were normal. The redness in the skin rapidly disappeared, but the tumor remained the same. One small gland was palpable in the axilla. The patient was operated upon on March 30, 1918. A radical breast operation was done for fear that we might be dealing with a scirrhous cancer and not a tubercular breast. One enlarged gland was found in the axillary space but none in Mohrenheim's fossa. The patient was returned to her room in good condition. Examination of the excised breast revealed a caseous area in its center. The gland presented a similar picture. The pathological report of L. A. Lynch was tuberculosis of the mammary gland. Unfortunately the tubercle bacilli were not found in the tissue, yet a section shows typical tubercles with giant cells. The other means of positive diagnosis, viz., cultural demonstration of tubercle bacilli and animal inoculation were not possible in this case, since the technician unfortunately placed the specimen immediately into formalin solution.

In reviewing the literature upon tuberculosis of the mammary gland, we find that the condition is not new but comparatively rare. Sir Astley Cooper, in 1829, reported macroscopical features of "Scrofulous Swelling of the Bosom," while Dubar, in 1881, proved, by microscopic examination, that the breast may be the subject of tubercular infection. From 1904 to 1915 100 cases were reported and as near as I can ascertain only 180 cases have been reported to date. One can only appreciate how rarely the breast is affected by comparing this case with the millions in whom foci of tuberculous infections are found elsewhere in the body.

Deaver and McFarland classify these breasts into: (a) primary and (b) secondary.

As the names indicate, the primary breasts are those in which the primary focus is in the breast. According to Demme, Pluyette, Orthmann, and Kramer (cited by Deaver and McFarland), the avenue of entrance of the tubercle bacilli may be through abrasions of skin of the nipple. Yet Babes has shown that tubercle bacilli may gain entrance through intact skin, and Ravenel has shown that the bacilli may gain entrance through intact

mucous membrane. In secondary infections of the breast, the primary foci most often are found in (1) the lungs or pleura; (2) the lymph nodes of the neck or axilla; (3) the bones, especially the ribs and sternum.

As to the exciting cause of these infections, slight trauma of the breast has been noted in a large percentage of the reported cases. This certainly was true in our case. When we take up for consideration the differential diagnosis, we should consider (1) simple pyogenic infection; (2) carcinoma or sarcoma; (3) broken-down gummata; (4) actinomycosis.

Briefly the characteristic symptoms are: (1) the rapidity of the disease process (Deaver and Geissler each report a case operated on within one month of initial symptoms); (2) early fistula formation; (3) involvement of lymph nodes; (4) pain when inflammation exists; (5) general condition of patient.

The treatment is simple breast amputation with excision of affected glands. The prognosis in these cases of primary tuberculosis of the breast is good, probably 100 per cent.

Prognosis in secondary tuberculosis will depend, of course, upon the primary focus. Braendle reports cases alive 13, 11, 9, and 8 years after operation but Strombery and Robinson (cited by Deaver and McFarland) report recurrences. Our case after 18 months has shown no symptoms of recurrence and is apparently well.

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SPERMATOCELES AND HYDROCELES CONTAINING SPERMATOZOA[1]

By RANDOLPH WINSLOW, M.D., F.A.C.S., Baltimore

AMONG the not very frequent pathological conditions of the testicle is spermatocele. A spermatocele is a cystic tumor containing spermatozoa, which usually arises from about the junction of the testicle and the epididymis and is situated behind the tunica vaginalis. A spermatocele is generally a rather small, inverted pear-shaped, cystic mass, extending upward along the spermatic cord. It is not painful and, as a rule, does not cause any discomfort or annoyance, except by its presence. Sometimes the cystic mass protrudes into the tunica vaginalis when it takes on the characteristics of a hydrocele. Spermatocele occurs usually in men between 20 and 40 years of age, but is sometimes found in old men; it is found more frequently on the right than on the left side but it may be bilateral. It has been supposed that the condition was due to degenerative changes in fœtal remains about the testicle and epididymis, such as the organ of Giraldé; the hydatid of Morgagni, the vas aberrans, and the vas du rete; but according to A. C. Cabot this is an error, for a spermatocele is a true retention cyst due to any process which blocks the outlet of the seminiferous tubules. The larger cysts in the young are due to obstruction of the vasa efferentia, while the small cysts of later life are due to senile cystic enlargements of the tubules. The cyst may be extravaginal or intravaginal. It is said to be extravaginal when the cyst develops in a direction in which there is no covering of tunica vaginalis, and this is the most common variety; and intravaginal when it arises from some portion of the testicle or epididymis which is covered by tunica vaginalis. The diagnosis is made by aspiration or incision, but the nature of the cyst may be suspected from its location between the testicle and the epididymis. When the tumor has projected into the tunica vaginalis, or is complicated

[1] Read before the Southern Surgical Association, New Orleans, December, 1919.

with a hydrocele, the differentiation will be difficult and is unimportant.

HYDROCELES CONTAINING SPERMATOZOA

The occurrence of six cases of hydroceles containing spermatozoa and of one of true spermatocele associated with a hydrocele, at the University Hospital, Baltimore, in the course of a few months, has directed my attention to this condition and has aroused my interest in it. How do the spermatozoa get into hydroceles? Is the hydrocele due to the presence of the spermatozoa, or does the hydrocele by pressure cause a communication between the seminiferous tubules and the cavity of the tunica vaginalis? I do not know of any observations that will answer these questions. It is conceivable that a trauma of the testicle could rupture tubules and permit the escape of sperm cells into the tunica vaginalis. In the cases of which I have notes, no mention is made of an injury, except in one instance, that of a man 55 years of age, who was struck on the scrotum when he was a boy. He had had a hydrocele for 40 years, but there is no way of determining how long the spermatozoa had been present in the sac.

I think it probable that in some cases, at least, true spermatoceles rupture into hydroceles and in that manner permit the ingress of spermatozoa into the sac of the tunica vaginalis. In one case there was a hydrocele with clear contents and contiguous to but not communicating with it was another cyst containing a milky looking fluid, which showed spermatozoa when examined with the microscope. It is quite possible that this cyst might have ruptured into the hydrocele, if it had remained longer without operation.

In another case, in which were evacuated 200 cubic centimeters of a slightly milky-looking fluid containing spermatozoa, several small cysts connected with the epididymis were observed. These cysts contained a similar fluid to that in the tunica vaginalis. I think it is probable that one of these small cysts had ruptured into the hydrocele.

In another case there were two sacs which communicated, one being the tunica vaginalis and the other extending up to near the external abdominal ring. This second sac may have been a true spermatocele. While the presence of spermatozoa in hydroceles is interesting, I do not know that any special significance is to be attached to this condition. The external appearance of the cyst does not differ from that of ordinary hydroceles, and the presence of the spermatozoa is only suspected when a whitish fluid is withdrawn. Possibly by transillumination, light would not show as clearly as when the sac contained straw-colored fluid. In the cases that have come to my knowledge, all were operated on under a diagnosis of hydrocele. Not always, however, is the presence of a whitish fluid in the tunica vaginalis due to spermatozoa; in some a chylocele forms, and the milky color of the fluid is due to oil globules. A microscopic examination in such a case would show oil globules and possibly filariæ as well. A remarkable case of a hydrocele containing spermatozoa was that of M. S., age 83 years, who had a very large hydrocele on the right side, which had been present for 30 years. This was tapped and 900 cubic centimeters of a whitish fluid was withdrawn. This fluid contained numerous actively motile spermatozoa. The patient's age and physical condition did not justify radical procedure and the case is noteworthy on account of the large size of the cyst, the numerous motile spermatozoa in the fluid, and the advanced age of the man.

The treatment of true spermatocele is usually excision, while that of the hydrocele containing spermatozoa is similar to that of ordinary hydroceles: excision of the tunica vaginalis, or suturing the tunica behind the testicle, or Andrews' bottle operation, etc. The results appear to be equally as good as in those of uncomplicated hydroceles.

My interest in these cases, however, is chiefly in the answer to the query: "How do the spermatozoa get into the hydroceles?"

PSEUDOMYXOMA PERITONEI IN MALE SUBJECTS

By M. G. SEELIG, M.D., F.A.C.S., St. Louis, Missouri

THERE is a sufficiently large number of recorded cases of pseudomyxoma peritonei to remove this disease from the category of rarities, nevertheless the number of studied cases is too small to furnish a satisfactory concept of the exact nature of this pathological process.

The striking, outstanding, and characterizing feature of the disease is the accumulation in the peritoneal cavity of a colloid exudate varying in consistency from a syrup to solid colloid masses. This exudate is the only constant accompaniment of the disease. In some instances there is a progressive cachexia, leading to death; in others the disease runs a benign course with perfect recovery after suitable operative procedure, and often doubtlessly without operation. In a large majority of cases the primary cause of the disease is the rupture of a pseudomucinous ovarian cyst; in a by no means small minority of cases the cause is the rupture of a mucocele of the appendix. Up to date the latter cause is the only one that has been found to be responsible for the disease as it occurs in males. In some cases the colloid material is confined in loculi whose walls are made up of a connective-tissue new-growth so firm and abundant that it fuses all the viscera into a solid mass, molded, as it were, into the peritoneal cavity. Some authors consider this process as a type of plastic foreign body peritonitis, others consider it as secondary myxomatous degeneration of the peritoneum, others as multiple cystic lymphangiomata, others as a type of innocent implantation metastasis, others as frank carcinosis peritonei, and still others as a specific type of peritoneal infection producing mucin. Virchow named the disease peritonitis gelatinosa, or peritonitis myxomatosa chronica; Péan called it maladie gélatineuse du péritoine; Vidal called it péritonite collide. Werth finally coined the term pseudomyxoma peritonei, basing it on Hammarsten's proof that the exudate was made up of pseudomucin, instead of mucin.

This by way of a short introduction suffices to emphasize both the interest that centers in the disease and the need of accurate case reports, in order to foster further study. My own experience has been limited to two cases (one of them already reported by Dr. Guthrie McConnell), occurring in male patients, with the appendix as the primary seat of the disease. I shall, therefore, limit my discussion to pseudomyxoma as it occurs in the male, appending a detailed case history and autopsy as a matter of record.

This limitation to male patients is made in order to emphasize the rôle of the appendix as a primary focus, from which as a central depôt the disease may spread to and involve the entire peritoneum.

It may be reasonably assumed that a knowledge of pseudomucinous cysts of the ovary is fairly general. The danger of rupture of this variety of cyst and likewise of the papillary cystadenomata of the ovary is almost universally appreciated, and the technique of the removal of these cysts has in late years been modified to meet these dangers. By no means may as much be said regarding the knowledge of the profession in regard to mucocele (so-called cystic degeneration of the appendix), or to diverticula of the appendix. A discussion of pseudomyxoma peritonei in the male will serve very concretely to emphasize both the importance and gravity of what we might otherwise casually consider as a mildly inconsequential appendicular lesion.

The pathology of pseudomyxoma peritonei is in the very first instance, striking, and as far as I know unique, in that the disease may run a benign or a malignant course clinically without furnishing any differentiating criteria, macroscopically or microscopically. The outstanding feature of the disease, pathologically, is the accumulation of a gelatinous material, which on analysis has been shown by Hammarsten and others, to be pseudomucin. The gelatinous material may be found circumscribed in the right iliac fossa or it may be

widely scattered throughout the peritoneal cavity. So far, no recorded case of pseudomyxoma in the male has shown any other source than the appendix as the primary source of the gelatinous material. Kaufmann, who refers to the disease as pseudomyxoma peritonei ex appendice, classifies the possible origins of the pseudomucin as from: (a) the rupture of a cystic appendix; (b) the rupture of a diverticulum of the appendix; (c) perforation of an acutely inflamed appendix. This last possibility is open to a very grave doubt for the reason that the content of an acutely ruptured appendix is purulent rather than mucinous; Elbe has shown that the essential conditions for the mucinous dilation of the appendix are a rapidly stenosing process, a sterile lumen, and an actively secreting mucosa.

The important fact is that the appendix itself is the sole responsible agent for the disease, as we encounter it in the male. It is the responsible agent, because under certain definite conditions the lumen of the appendix or diverticula therefrom contain pseudomucin and epithelial cells. It has not been established whether the escaped pseudomucin provokes a reactionary pseudomucinous peritonitis, or a myxomatous peritoneal degeneration, or whether the escaped epithelial cells are originally responsible for the pseudomucin, and continue to manufacture it after their spread and implantation throughout the peritoneal cavity. In this connection it is significant to quote the figures of Elbe showing that in 7,602 routine autopsies, cystic appendices were encountered 33 times (nearly 0.5 per cent) and that in 2,654 operations for appendicitis, cystic appendices were found 17 times (nearly 0.7 per cent).

The course of events following the escape of the pseudomucin varies.

1. The exudate may be limited in its escape, to the right iliac fossa, where it constitutes itself as a saucer-like, kidney-like or sausage-like mass, that is slowly encapsulated by connective-tissue growth. The connective-tissue growth tends from the outset to infiltrate into the mass as tiny tendrils, the tendrils growing into well-developed strands later. The mass of pseudomucin is usually coursed with fine blood vessels and frequently peppered with small hæmorrhages. The connective-tissue capsule tends to establish firm adhesion to the neighboring peritoneum.

2. The exudate may not be localized to the right iliac fossa, but may escape to various and multiple intraperitoneal sites, setting up the typical peritoneal productive reaction which results in loculation of the pseudomucin into cyst-like cavities, to which neighboring peritonealized structures become adherent. Sometimes, in this form of spread, the pseudomucin becomes delicately encapsulated and hangs from the intestinal peritoneum as little polypi.

3. It is possible for the exudate to be absorbed entirely—Lejars reports such instances and I have under observation at present a patient, who in all probability is absorbing a pseudomyxomatous mass.

4. There may be wide dissemination of the exudate with a tendency to marked secreting activity on the part of the disseminated material. These are the cases that present the clinical appearances of an ascitic abdomen, with accompanying symptoms of cachexia and general physical deterioration. In this group we may encounter infiltration of the abdominal wall. In spite of all these earmarks of malignancy, there is clear-cut clinical evidence of the benign nature of this type of the disease, in several instances. In other recorded cases, this type of the disease has carried patients off exactly as does widespread intra-abdominal carcinosis. In these cases, where the dissemination is widespread, there is an accompanying adhesive peritonitis which tends to bind and fuse all the intra-abdominal organs into an inseparable mass. Kinking of the intestine and consequent intestinal obstruction is naturally a likely complication.

From the histopathological point of view the chief interest centers around the fate of the epithelial cells which usually spread with the exudate. According to Cagnetto the contents of a cystic appendix is made up of mucus, leucocytes, and epithelial cells. The epithelial cells are usually found lining the various cyst cavities, and vary in size from low cuboidal to high cylindrical. By some authors

they are made responsible for the metastatic secretion of the pseudomucin, by others this origin of the exudate is denied. It is fairly generally conceded that as the pseudomucinous exudate accumulates within the new formed connective-tissue capsule the intracapsular pressure destroys the epithelium lining. If this is a correct assumption, it introduces an element of confusion in establishing definite criteria by which we may establish a diagnosis of carcinoma. In the present state of our knowledge, it is futile to speculate on this problem[1]. The facts are that certain cases of pseudomyxoma showing an abundant distribution of epithelium recover completely after incomplete operation, and other cases in which, it is almost impossible to find any epithelial cells, run a clinical course which is identical with that of carcinoma.

The symptomatology of the disease varies within broad limits according to the stage to which it has progressed, and the type of pathological course that it follows. It seems rational to assume that the most benign type due to a ruptured sterile appendicular cyst, may run its course symptomless, the exudate being absorbed without ever having made its presence known. There are other cases with a history of mild abdominal symptoms in which the sausage- or kidney-shaped tumor, found in the right iliac fossa, constitutes the most important symptoms. These cases shade off clinically into the more grave cases with distended abdomen, multiple palpable masses and signs of general physical deterioration. In no instance is there a satisfactory syndrome on which to base a diagnosis with any degree of assurance. In my second case I was able to make the diagnosis tentatively owing to the fact that the patient's appendix had been removed at an earlier date, for some unknown type of appendicular disease, that a postoperative fistula had established itself, and that from this fistula, when I examined the patient, there exuded a thin, mucinous exudate.

[1] This question is clouded by two case reports (Hueter and Kaufmann) in each of which, pseudomyxoma leading to death with manifest clinical evidences of cachexia, was accompanied by carcinoma of the appendix. Both these authors contend that the cases could be differentiated from colloid carcinoma of the peritoneum on the basis of scanty cell distribution. I cannot bring myself to believe that in either of these cases or in the case reported by McConnell there is sufficient warrant to exclude carcinoma.

The prognosis of the disease varies from excellent to hopeless. As a rule, it may be stated that if operative interference is instituted early before wide dissemination has occurred, a cure may be expected regularly. The widely disseminated types (irrespective of whether subsequent investigation classes this type as pseudomyxoma or as carcinoma) offer the most hopeless outlook.

Treatment consists in removing the primary focus of disease—the appendix—and scooping out that portion of the exudate which can be reached conveniently and with safety, without any attempt to clear the abdominal cavity of its entire pseudomucinous content.

The following case history is appended as a matter of record:

The patient, a male, white, 42 years old, entered City Hospital on December 12, 1912, complaining of abdominal pain, abdominal distention, weakness, and loss of weight. About 2 years ago the patient gradually developed a dull intermittent pain in the region of the umbilicus coming on about one-half hour after meals, and a feeling of discomfort between these attacks. At this time, however, there were no gastric symptoms such as pain, eructations, nausea or vomiting, and the appetite was good. The bowels were constipated, 3 days often elapsing without movement.

This condition continued with very little variation for about one-half year when, after a fishing trip, the patient returned home with a more or less severe cramp-like pain in the lower left abdomen. This lasted all day and finally compelled him to call in a doctor, who gave relief by the use of some tablets and a physic. At this time no other symptoms had developed.

Five months after this attack the patient noticed that his abdomen began to enlarge. This continued while the patient became thinner. Doctor then told patient that he had dropsy and would have to be tapped.

In October of 1912 the patient consented to an operation, which was done under an anæsthetic, and in which he presumed some fluid was removed. For 2 or 3 months previous to this operation the patient had attacks of vomiting usually in the morning, but occasionally at various times during the day. On inquiry it was learned that the operating surgeon had diagnosed the case appendicitis and had operated on that basis. Other details could not be learned from the surgeon, who had not kept a record of the patient.

The patient stated that the wound was slow to heal after the operation, and the dressings were saturated with a clear yellow fluid which looked like urine. This discharge continued for a week. Three weeks after the operation, he walked home. Still

weak at this time, he remained in bed and getting up only occasionally and becoming progressively weaker until he finally entered the City Hospital on the above date.

Family history. The patient's father is dead, the cause of death being unknown. His mother died of tumor, the nature of which is unknown. There was no history of tuberculosis, nervous or mental diseases, skin diseases, rheumatism, nephritis or cardiac conditions, etc.

Past history. The patient had measles, parotitis, and varicella in childhood. Had an attack of rheumatism 3 years ago. Had gonorrhœa once in his younger days, which was not followed by a skin eruption, sore throat, falling of hair and other symptoms of secondary lues. He had been operated upon as mentioned above. No history of any accidents.

Habits. Bowels more or less constipated. Sleeps poorly and somewhat irregularly. His occupation was that of shoeworker. Drank beer and whisky to excess some years ago but more moderately for the last few years. Used smoking tobacco. Denied the use of drugs. Diet and hygiene were found to be only fair.

Physical examination. An emaciated anæmic white male about 5 feet 10 inches tall; development and nutrition poor. No deformities, somewhat depressed both mentally and physically although apparently contented.

Head and neck. Light brown hair, gray eyes, left pupil larger than right, somewhat irregular and both reacted sluggishly to light. No nasal or oral findings. No facial palsy. The tongue was central, clear, and presented a slight, fine tremor. No cervical pulsations. Cervical lymph nodes palpable.

Thorax. Flat chest. Anteroposterior diameter somewhat diminished in proportion. Emaciation quite evident. Apex beat seen and felt in normal position. No increase in tactile fremitus. No increase or diminution in vocal fremitus. No abnormal areas of dullness or percussion. Tubular breathing throughout the thorax. No râles. No cardiac murmurs.

Abdomen. Considerably enlarged and ovoid. Firm but no marked tension. Slight tenderness on deep palpation, not well defined. On palpation the abdomen gave the impression of a general abdominal mass extending to the right and left, moderately firm in consistency, irregular and ill-defined and not very movable. No fluid percussion wave. Rectal examination elicited an ill-defined firm mass in the region of the prostate. Abdominal skin reflexes equal but somewhat sluggish. The abdominal organs could not be outlined. Inguinal glands palpable. A discharging sinus in the line of a linear scar below the umbilicus and in the midline, the discharge being yellowish in color, and mucoid in consistency.

Extremities. No deformities or paralyses. General weakness. No disturbance of skin sensations. Pulse fairly full, regular, and of good tension.

Urinalysis. Specific gravity 1,023, acid; cloudy; amber; no albumin or casts; uric acid and urate crystals.

Blood examination. Positive Wassermann reaction.

Fæcal examination. No blood observed after a meat-free diet.

Diagnosis. Syphilis malignancy(?), pseudomyxoma peritonei(?). The last two conditions are strongly suspected on account of the general condition of the patient, the abdominal physical findings, the nature of the discharge and the history of an appendectomy.

Course. Treatment was begun along a dietetic basis, efforts being made to increase the patient's resistance, hence stomachics, tonics, and a liberal diet were ordered. The sinus was regularly dressed with an aseptic dry dressing. Within a week the positive Wassermann was obtained and the mixed treatment of potassium iodide and injections of mercuric bichloride solution were instituted. At the end of a month of this treatment, patient's general condition was improved, with no marked change of the local condition.

Then salvarsan was injected intravenously which resulted in the discharge becoming more profuse for a few days but after a week the abdomen had become considerably smaller, the discharge became less and the patient generally improved.

This improvement did not last long when, at the beginning of the third month of treatment, it was noticed that both legs became more and more œdematous and finally skin excoriations were seen. The etiology of this was ascertained as disturbed circulation. In the meantime the discharge from the sinus became more profuse. About 15 days' treatment by rest in bed, elevation of the limbs, and local applications of zinc oxide ointment caused the leg condition to disappear but the discharge from the sinus became more profuse.

In a few days the patient was put into a wheel chair again but his general condition was found to be worse, with loss of appetite, pallor and emaciation more marked. Five days later the abdominal sinus became a fæcal fistula and with it came weakness and so much exhaustion that the patient was obliged again to take to his bed.

From this time on, patient became progressively weaker. Cardiac stimulation finally proved fruitless and, unable to talk from the marked weakness and collapse, the patient died of exhaustion, February 23, 1913.

Autopsy report by Dr. D. L. Harris. The body is that of an extremely emaciated white male, measuring 165 centimeters. Rigor mortis absent; livores very few in the dependent parts of the body. Eyes are deeply fallen in. Intra-ocular pressure slightly reduced; pupils equal, measuring 0.4 centimeters. Body very pale; skin over both limbs dry and scaly. Abdomen slightly distended. Umbilicus cannot be seen. In the median line about the middle of the abdomen there is an opening measuring 0.4 centimeters, oval in shape, through which greenish yel-

low semifluid, creamy-like material is exuding. On opening the abdomen, panniculus nearly absent; muscles very thin, brownish red. The abdominal cavity is filled with a greenish yellow gelatinous mass, which covers the intestines and all the organs. In the dependent parts of the pelvis and in both hypochrondria there is a considerable amount of a semifluid material of a fæculent odor and peasoup-like appearance. The viscera cannot be separated from one another; the liver is attached to the diaphragm or rather separated from the diaphragm by a thick layer of this half-translucent jelly-like material. This layer measures from 5 to 10 centimeters. The intestines are all bound together in one mass and the coils are so firmly adherent each to the other that in trying to separate them, their walls tear and fæces exude. The intestines are of a light gray, distended with gas, and very thin. Appendix cannot be seen or found. The omentum and stomach are concealed under the jelly-like mass, and the contour of the stomach cannot be felt. Bladder is distended above symphysis and is filled with clear urine. The surrounding tissue and prostate are very firm and covered by numerous yellowish white nodules, which are prominent, moderately firm in consistency, and have the size from a pinhead to a small pea. They are not transparent and appear cheesy-like. They differ very much from the translucent jelly which covers the peritoneal cavity and organs. The organs are taken out *in toto*, and large cross sections made through the entire mass. Only the kidneys could be separated from this mass. Each of these organs is very small (100 gms). Capsule strips easily, leaving a perfectly smooth surface of a reddish yellow color. The cut surface shows regular structure. Cortex and medulla are pale. Glomeruli are visible and pyramids distinct. The pelvis is moderately extended mucosa pale. On the left kidney there was found a small white nodule, measuring 1 millimeter, of a yellowish color and opaque. Spleen cannot be separated and cross sections show a very firm grayish organ, whose cut surface has a honey-combed appearance due to very much thickened septa between which are small whitish cysts either empty or filled with the jelly-like material. The organ is very firm and cuts with difficulty.

Section through the liver shows a very thin, dark brown organ, slightly increased in consistency. The liver structure cannot be distinctly made out. The liver, as mentioned above, is surrounded by a thick layer of the jelly-like material.

Sections of the pancreas show a very firm organ, pale yellow in color, and smaller than usual. The mucosa of the stomach is pale.

On removing the sternum, both lungs are moderately contracted partly covering the heart. Pericardial sac is very thin, smooth and shining. It contains several cubic centimeters of a clear fluid.

Heart is small, much smaller than the owner's fist and weighs 190 grams. The right side is flabby; left moderately contracted. The epicardium is free, smooth and shiny, of a reddish, brownish color. The mitral scarcely admits two fingers. The tricuspid easily admits three fingers. The myocardium is brownish and measures 1.2 centimeters thick in the right side. Bicuspid and tricuspid valves are smooth and tender. The aortic cusps are tender. The wall of the aorta shows multiple irregular patches, measuring from 1 to 3 centimeters. They are prominent, white, opaque in color and not calcified. The elasticity of the aorta is still present.

Right lung weighs 370 grams; left the same. Pleural surfaces perfectly smooth. The lungs are grayish pink in the upper parts and reddish in the lower. Both organs pit on pressure. On cut surface upper lobes are grayish. Middle and lower lobes are red, congested, and on slight pressure frothy, blood-stained fluid is exuding in abundance. Bronchi moderately congested, filled with frothy fluid. Bronchial glands are not enlarged and slightly anthracotic.

Brain. Dura mater of a good tension; gyri are not flattened. Ventricles contain usual amount of clear liquor. Consistency of the organ not diminished. On cutting, tissue appears rather pale and blood points are not numerous.

Anatomical diagnosis. Pseudomyxoma peritonei; peritonitis chronica (with purulent and fæcal exudate in abdomen); brown atrophy of the heart; early arteriosclerosis of aorta; œdema of the lungs.

Microscopical findings. Sections from the omentum, intestine, spleen, kidneys, liver, pancreas, bladder, and diaphragm, and from the lungs and heart were made. Microscopical examinations of these show the process to involve only the peritoneum and the parenchyma of the spleen. Within the substance of the liver, kidney, and pancreas, there is none of the myxomatous material. The process does not extend beneath the visceral peritoneal layer of the intestines.

Sections of the omentum show a marked fibrous connective-tissue proliferation with numerous areas of extensive lymphatic infiltration. Covering this in varying degrees of thickness are laminated, cell-free layers of unformed material which stain faintly and diffusely. Numerous cysts here and there are lined with a single layer of epithelial cells which, in proportion to the distention, are either tall, columnar, cuboidal or flattened. These epithelial cells may be found in all degrees of deterioration. In larger cysts where the stratified myxomatous material is more extensive, only the faint outline of these cells is discernible.

In one section, which included the liver, the diaphragm and the thickened intraperitoneal deposit, Glisson's capsule and the peritoneum covering the liver is easily made out. Upon this, lying within the fibrous tissue bands, are small cysts containing within their walls the mucinous deposit. These cysts are lined with a single layer of cuboidal and columnar epithelial cells.

In the omentum there is an extensive deposit of the mucinous material held within a connective-tissue meshwork. There are here numerous areas of

lymphatic infiltration. The spleen can scarcely be recognized; only a few scattered islands of lymphoid tissue mark its site. The fibrous connective tissue in-growth is here especially marked.

The epithelial cells lining the cysts are preserved only here and there. For the most part merely a faint and obliterated outline of these cells remains. It appears that degeneration follows as rapidly as proliferation advances and that in this we have one explanation of the chronic nature of the disease.

These cuboidal epithelial cells are always in a single layer and do not grow upon stalks or tend to form papillary outgrowths. Very few goblet cells were observed.

THE PELVIC ARTICULATIONS DURING PREGNANCY, LABOR, AND THE PUERPERIUM

An X-ray Study[1]

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THE question as to whether a woman's pelvic girdle expands in pregnancy and labor has been a matter of interest since earliest time. The belief that it separates has had many advocates and has been confirmed by many positive reports by earlier observers. Quite likely the majority of these were pathological cases, yet there is no doubt but that joint changes greatly aid labor in some of the animals.

As early as 1812 Le Gallois showed that the pelvis of the female guinea pig was only about half the size of the fœtal head and that parturition was possible only by an increase in size of the pelvis since the head measured 20 millimeters and the pelvis but 11 millimeters. He showed that 3 weeks before parturition, the ligaments joining the pubis became thick, soft, and malleable so that the pubes gradually opened, the ilia swinging on the relaxed uterosacral joints as if on a hinge. At time of parturition, there was a separation of at least one finger's breadth and very often two. Immediately after delivery, the shrinkage began, and the symphysis in a few days receded to normal width and consistency. Knox, in 1839, observed in a pregnant seal a separation of the symphysis pubis and elongation of its ligaments to the extent of nearly 2 inches. Barlow, in 1854, described changes in the pelvic joints of the parturient cow which increased the size of the pelvis, and Duncan later demonstrated these specimens before the Edinburgh Obstetrical Society. The pubes remained fairly well held together and the changes were chiefly in the sacro-iliac joints. The sacro-iliac joints in the non-pregnant animal are firmly bound by a substance resembling intervertebral discs, yet in pregnancy the bony surfaces become smooth and lubricated and the surrounding fibrous ligaments markedly relaxed. The sacro-iliac ligaments of moderate thickness and in a state of tension in the non-pregnant cow were much longer and thicker in the pregnant animal and with such lack of tension as to permit the sacrum to move quite freely upon the ilia, and vice versa in an anteroposterior direction and to allow the ilia to separate behind. The fact that the cow's rump changes its plane a few days before labor has long been known to cattle raisers.

It seems quite likely that similar observations were responsible for the Hippocratic doctrine that a woman's pelvis separated in her first labor and remained so thereafter. The majority of texts state that Vesalius did much to overthrow this doctrine by his dissections, in which he demonstrated that it was impossible for the pelvis so to widen, as did Realdus Columbus who claimed that woman's pelvis was an unyielding ring. Yet we find from the literature that these observations made little impression for more than a century, possibly because Severin Pineau in 1599 described a separation in the pubis of a woman who suffered punishment by death 10 days postpartum, for the murder of her

[1] From the Women's Clinic, University of California Hospital, San Francisco, read at the American Gynecological Society, June 14, 1919.

Fig. 1. Non-pregnant control, virgin pelvis.

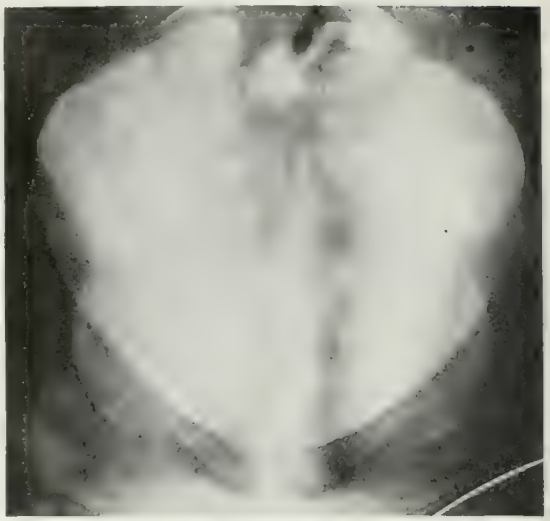

Fig. 3. Non-pregnant control, II-para. Symphysis ruptured at first labor, low forceps delivery. Patient in bed three months, crutches nine months, cane until 2 years. Symptoms extremely marked after fifth month of second pregnancy, 3 years after first labor. Plate 15 months after second labor when very slight symptoms present when patient turned suddenly.

child. The dissection done in the presence of Ambrose Pare proved the plausibility of the older tenet to their complete satisfaction.

The weight of Pare's authority and the value of positive evidence prevailed. The majority believed that Vesalius and Columbus had dissected cases against the rule. It appears that of the obstetricians of the 17th and first half of the 18th century, Mauriceau alone rejected the Hippocratic doctrine. The pelvis is so small, writes Pare: how can a baby come through so small a space unless the pelvis yields?

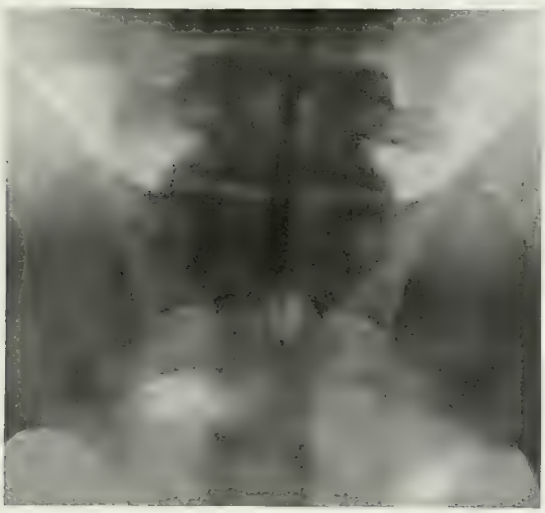

Fig. 2. Non-pregnant control, virgin pelvis. Sacro-iliac symptoms.

Fig. 4. Pregnant control, 16-year nullipara, at 4 months. Sacro-iliac symptoms. Wide sacro-iliac synchondrosis.

Fig. 5. Pregnant control. Wide rachitic pelvis. Has had one cæsarean section. Now 4 months in second pregnancy.

With the long and bitter controversy waged concerning the justifiability of symphysiotomy, the subject gained new importance. Its earlier advocates believed that the operation was indicated when the pelvis did not properly give during labor.

Our modern belief was first well stated by Baudelocque who admitted that the pelvis occasionally separated, as was evidenced by the reports of many positive cases, but denied that it did so as a rule, since he sought it unsuccessfully in the fresh bodies of twenty women who died following labor. Since considerable separation did not occur as the rule, he deemed that a smaller one would not aid labor materially since a pubic separation of one inch added only two or three lines to the essential pelvic diameters.

Nor did Smellie believe it was a frequent occurrence. He cites one case in his text in which symptoms attended the pubic separation, disappearing 2 months following labor, a case related to him by Smollett. He says in discussion that he himself had never seen such a case but that Lawrence had a specimen, the pelvic bones of which were separated one inch from each other, and that he had seen one other such specimen owned by Dr. Hunter. The view that the pelvis actually opened, lost ground. "Will not the fœtal head" writes Roederer, "give sooner than the pelvis?"

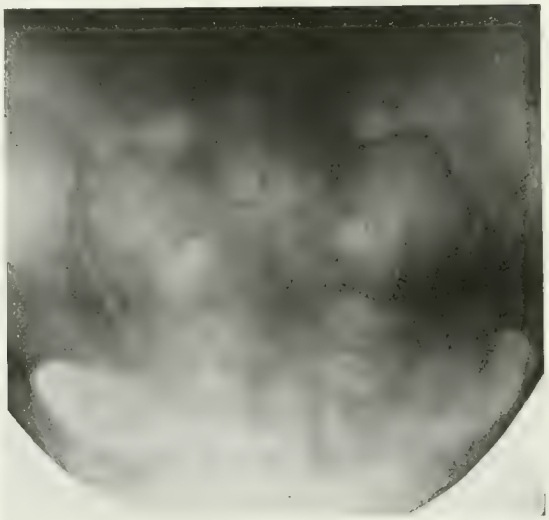

Fig. 6. Pregnant control. Nullipara, 12 days before labor.

Yet the literature prior to that time cites many positive cases. Spigelius, Bauhineus Riveamus, Diemerbroeck, Arniseus, Bianchi, Gregory Pineus, Duvernay, Bertin, Levret, Santorini, Hunter, and others had recorded a separation of the pubis in dead parturient women. Hildanus, Guillemeau, Van Solingen, Puzos, Veslingries, Soumain, Bikker, Arnauld, Morgagni, Madame Boivin, Madame La-

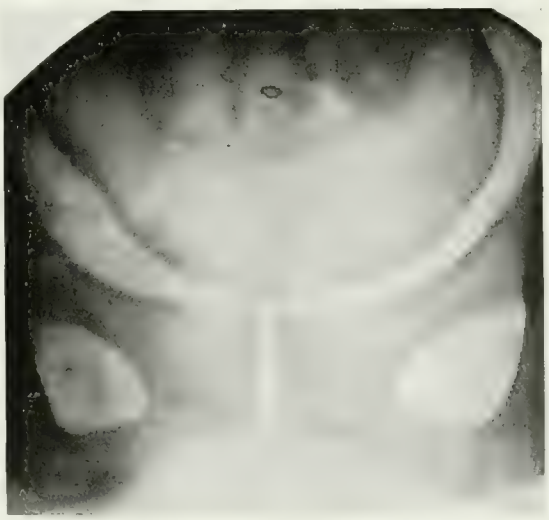

Fig. 7. Labor and puerperium. I-para. First stage of labor.

Fig. 8. Labor and puerperium. I-para. Three weeks after first labor.

chapelle, Jacquémier, and others made similar reports from the living subject. Pare, Peu, Lachapelle and Smellie record the separation

Fig. 10. Labor and puerperium. Six weeks after labor.

Fig. 9. Labor and puerperium. Nullipara. Second stage. Wide sacro-iliacs and rather wide symphysis.

of one ilium from the sacrum, while Breit reported similar dislocations in both sides.

Sufficient examples of pelvic separation had been reported to excite interest in its mechanism. The older observers usually regarded the symphysis pubis as a fibrocartilaginous joint very often without mention of binding ligaments and considered the accumulations of fluid in its center as degenerations. Yet Albinus, when in Leyden, classed both the symphysis pubis and sacro-iliac joints as bone joints lined with synovial membrane. William Hunter independently about the same time came to the same conclusion and showed that in parturient women a membrane often extended over nearly the entire articulation and contained fluid. One hundred years later, Senoir advanced similar views before the Paris Academy contending, as did Hunter, that an effusion of serum caused the separation of the bones and relaxation of the ligaments, and that the joints were lined with synovial membrane. Luschka, in 1854, made similar observations, recording the contrasting pictures of the pelvic joints of two women of 21, one non-pregnant and the other recently delivered, as well as the report of the findings of a woman of 36 who died late in pregnancy.

Fig. 11. Labor only. Nullipara, second stage, head on perineum, wide sacro-iliacs.

Yet the whole subject of the behavior of the pelvic joints in pregnancy and labor is best summed up in Duncan's essay in 1867. He emphasized the error of teaching that the pelvis is immobile since the sacrum normally rotates within small limits on a transverse diameter. This mutation of the sacrum occurs in men and women. When standing, the body weight pushes the promontory backward, thus increasing the length of the conjugate vera. When squatting, the promontory is shoved forward and the coccyx backward, thus increasing the diameter of the outlet. With the softening of the pelvic joints, which occurs normally during pregnancy, the movements of the sacrum are increased. Nature utilizes them to aid labor and guides the woman in the first stage to walk about to increase the inlet while the head is high. When the presenting part reaches the pelvic floor, the reflexes cause the patient to draw up her knees and press down. The contracting abdominal muscles pull the pubis up and thus increase the outlet. Moreover they push with their feet wide apart in a position to take advantage of any separation of the pubis. His dissertation clearly explains the value of

Fig. 12. Nullipara, generally contracted pelvis. Head low on spines, cervix 6 centimeters, some overlapping of fœtal head.

the so-called Italian position which was in use for many centuries before and which was described by Walcher.

Poullet, in 1864, made some observations to determine the force necessary to rupture the symphysis pubis and found that the pubic joint of seven women who died during the puerperium broke under forces of 170 to 200 kilograms. Since forceps extractions usually require less than 25 kilograms, it is apparent that the softening of the joints is an

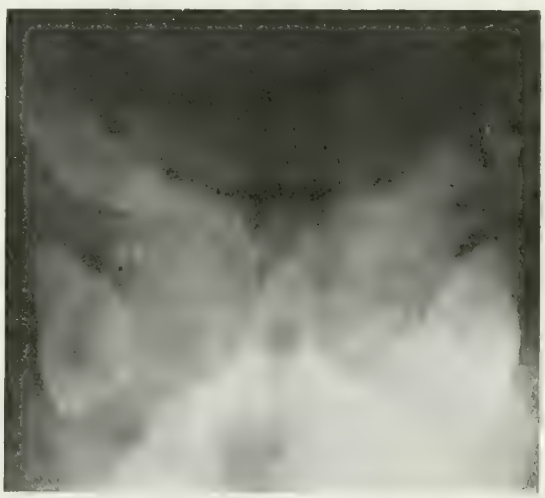

Fig. 13. Eighteen-year old primipara with wide symphysis. X-ray taken early in labor. Symphysis returned to normal size 18 months after labor.

Fig. 14. Eighteen-year old primipara with wide symphysis, returning to normal size 18 months after labor. X-ray taken 45 days after labor. Symphysis still wide but narrower than in Figure 13.

Fig. 15. Eighteen-year old primipara with wide symphysis, returning to normal size 18 months after labor. X-ray taken 45 days after labor. Labor shown in Figure 13. Symphysis now has returned to normal limits.

etiological feature in rupture of the symphysis during labor.

The observations of Budin that the symphysis is mobile during pregnancy have been confirmed by a host of observers, and Cantin's observations are of interest in showing the amount of separation present in a series of Cantin in 500 cases found an increased mobility over that of non-pregnant controls in all but 2 per cent of cases. Yet the pubis was not separated more than 3 millimeters in any of his series, and only in 16 per cent was it more than 1 millimeter. Symptoms were present in 15 per cent of the total and 70 per cent of those giving symptoms had changes in their gait. The recent work of Goldthwaite is known to all.

My study has developed from observations in an effort to use the X-ray for diagnostic aid in gynecology and obstetrics as well as from interest in a case of rupture of the symphysis during labor which came under my care 3 years later with marked symptoms in her second pregnancy; and by the great number of sacro-iliac slips seen in my service in spite of proper corseting. Since we are not aware of a series of X-ray studies of pelvic articulations, we have investigated a series of cases. It is difficult to present conclusions because of the constant chance of error in deductions from the X-ray plate. Only one woman studied has had marked widening of the symphysis during pregnancy, with a return to normal limits when seen 15 months later. It appears, however, as if the widening of the sacrosciatic spaces was almost a constant phenomenon.

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TUBERCULOSIS OF THE JOINTS

Rollier's Heliotherapy[1]

By GUSTAV SCHWYZER, M.D., F.A.C.S., Minneapolis, Minnesota

WE realize that a large amount of material should be the foundation for conclusions in such a vast subject as joint tuberculosis. It is, therefore, with some hesitancy that I bring before you my small amount of operative work on such cases. Still some valuable deductions at times may come from a limited number of cases as we observe them in private practice.

The study of the different phases of tuberculous joints is so extensive that we can only touch upon the most important features.

Etiology. The two main channels by which the human body becomes infected with tuberculosis are: the lungs and the alimentary canal.

In children, Fraser has found 60 per cent of all the joint tuberculosis to be of bovine type, an infection directly traced to tuberculous cow-milk. The alimentary route in children, therefore, is predominant.

In adults the bovine infection becomes negligible. The tuberculous infection of the joints is here of more secondary nature; in the lungs we have to look for the probably primary focus.

Of less importance are the channels for tuberculous infection from the tonsils, from the pharyngeal mucous lining, and infected gum tissue. They are the direct source of lymph-gland infection in the neck.

Joint tuberculosis is prevalent in the first two decades of life.

The question whether trauma is an etiological factor for the start of the disease has given rise to much dispute. Not only do we find almost constantly a minor trauma mentioned by the patient in the history of the sickness, but also experiments point to the fact that traumata, and surprisingly often light ones, have a distinct significance in the start of the disease (Krause, Pietrzikowski, etc. cited by Fraser). It is obvious that a previously dormant tuberculosis of a joint when exposed to injury may progress to an acute state.

The hip and knee joints are most frequently affected by tuberculosis; the elbow, ankle, wrist, and shoulder follow in frequency as enumerated.

Pathology. There are two principal types of infections to be considered: one an invasion from a nearby bone-focus; the other through the capsule from a tuberculous focus in the neighborhood, especially tuberculous synovitis.

The most frequent is the infection of the joint from the side of the bone. Years ago Volkmann said that in children the tuberculous arthritis always starts from an osteitis, respectively osteomyelitis, and even Koenig in his monograph on coxitis avoids speaking of a primary and secondary synovitis. Still he admits that he has seen cases of simple tuberculous synovitis in children. The start of the arthritis is then overwhelmingly from a bone-focus. This focus may for some reason become walled-off by osteosclerosis.

We have observed such a case in the upper epiphysis of the tibia in a girl of 16. The X-rays showed us a well defined focus in the bone, of the size of a hazelnut. Early operation brought on a definite cure and the imminent joint tuberculosis was thereby prevented. The process in the bone during 14 years of observation has not recurred to date.

If contrary to this the process in the bone is of more acute, more violent character, this osteomyelitis spreads rapidly; great rarefaction of the bone takes place; the bone lamellæ become destroyed; they are replaced by tuberculous granulations; and caseation and necrosis set in.

This can lead to a secreting fistula toward the outside, or the process can perforate into the joint. In this latter case, erosion and perforation of the cartilaginous covering of

[1] Read before the Western Surgical Association, Kansas City, December 5, 1919.

the bone follows, and the joint cavity has to surrender to the entering tuberculous infection.

On the other hand, the primary tuberculous synovitis, also called synovitis fungosa granulosa (the white swelling-tumor albus), is of a more chronic character. It has a greater tendency to heal, especially in children.

Numerous, distinct tubercles form in the synovialis which is ultimately replaced by tuberculous granulations. In lighter forms of infection, the joint contains a serous hydrops (Koenig). The fluid is yellowish and clear. Here conditions can remain unchanged for a long period of time. White flakes in that hydrops are fibrinous deposits (hydrops fibrinosus). At times we find rice-bodies, probably originating from this fibrin.

In the tuberculous process the cartilage does not take an active part.

The peculiar white swelling, so characteristic in the knee and elbow joints that the diagnosis often can be made *prima vista*, is due to hyperplasia and infiltration, not only involving the capsule, the ligaments, and the tendon sheaths, but also the subcutaneous tissue.

The tuberculous granulations can spread into the surrounding tissue outside of the joint proper. If they undergo caseous or purulent degeneration, cold abscesses or fistulæ will result. Such abscesses have become significant for the diagnosis, as in psoas abscess. If in coxitis we find an abscess at the groin and upward from it, the bone-focus lies in the acetabulum, while an abscess directly in front of the hip-joint tells us that the focus is in the femur.

For the knee the formation of bulky masses of fungous granulation tissue on the capsule is a characteristic and outstanding feature for this joint. The elbow and shoulder joints are more frequently the seat of caries sicca. The hip-joint infection is characterized by a particularly great destruction of bone tissue, of the femur head, and of the acetabulum.

Our cases of joint tuberculosis were of a distinctly advanced character. Conservative treatment had failed to bring on a cure. We were compelled to do extensive arthrectomies and resections in all of our cases.

In every case the pre-operative diagnosis was established beyond a doubt. We will merely mention that radiography and at times the subcutaneous tuberculin test always allowed definite conclusions.

TREATMENT IMMEDIATELY PRECEDING OPERATION

We are holding the view that a general preparatory treatment has to precede operations, regardless of the mode and length of time of the previous conservative treatment. By this we aim at an improvement of the resistance of the body in general, providing for fresh-air and light; we encourage the patient's appetite as much as possible in order that a large amount of substantial food will be taken. In the majority of our cases Sahli's tuberculin treatment was given.[1] This preparatory period extending from 1 week to 2 months gives us a good chance for closer observation of the patient. We must obtain a very exact knowledge especially of his lungs and kidneys, furthermore an exact temperature picture which is of additional value for comparison later on. Very accurate notes should be taken, telling us as much as possible of the clinical pathology of the diseased joint. We must try to locate the bone-foci. We must thoroughly test the function of the joint actively and passively. In young people the examination is often hampered by lack of self-control or by involuntary muscular contraction. In these cases a general anæsthesia for the examination is recommendable.

X-ray examination is, of course, indispensable.

PREPARATION FOR OPERATION

The preparation for operation has always been done with a view to ascertain an ideal asepsis. The field of operation is carefully shaved, and the covering skin surgically prepared the day previous to the operation. The patient arrives at the operating room with an aseptic dressing covering a wide area.

It is our practice to operate upon such joints under Esmarch constriction wherever feasible.

[1] We carefully followed his instructions, avoiding any elevation of temperature which in our estimation can safely be done by using Sahli's tuberculin prepared in the hands of Dr. Beraneck, at Neuchatel.

Only with this bloodless procedure under Esmarch are we able to differentiate between healthy and diseased tissues, particularly bone tissue.

OPERATIVE PROCEDURE

As to the methods of operating, incision and so on, we can briefly say that we generally followed Kocher's ways. We always were impressed that through his incisions good access could be gained to the entire diseased area, and it is most important that all the tuberculous tissue be carefully excised by exact dissection.

If the disease is confined purely to the synovial membrane of the joint, we limit our work entirely to the removal of this membrane, thus avoiding complete ankylosis. But if the bone is involved, the bone ends are exposed by energetic dislocation. We strip back the healthy, outer integuments and turn them back like the cuff of a sleeve. Now the diseased part of the bone is cleanly removed. If we aim at a complete ankylosis, a good apposition of the bones is imperative.

In every case we have used iodoform powder. Contrary to the general routine, we prepared the iodoform powder previously by boiling the same for half an hour in a 1:500 bichloride solution. This powder is rubbed into the entire wound surface, the bone, and the soft tissues. The superfluous, loose part of it is washed away with saline solution. Thus we always have avoided dangerous degrees of iodoform intoxication.

In all our resections we drained the wound cavities with rubber tubes surrounded by washed-out iodoform gauze strips. Our buried suture material consisted of silk and linen. Silkworm-gut is the best material for the surface. An abundant amount of absorbant gauze and cotton is used for dressing. A plaster-of-Paris cast is put on before the Esmarch bandage is released. The drains are removed through windows in the cast within a week.

Though the bleeding into the cast was often considerable, we never noticed any alarming hæmorrhage. The first cast was always made quite heavy with the intention to leave it on from 4 to 6 weeks. After that time the wounds were closed and in affections of the lower extremity the patient was allowed to leave the bed in a lighter cast. None of our hip or knee resections remained in bed longer than 6 weeks. The patient was sent home in the second cast with the advice to return in 2 to 3 months. A much shorter time is needed following operation on the upper extremities.

Fortunately in all our cases we did not have to resort to amputation. Only one case left with a fistula after a resection of the elbow-joint. A second resection 11 months later brought on a definite cure also in this case.

REVIEW OF THE CASES

Case 1. Mrs. Maud R., age 24. Resection of right middle metacarpophalangeal joint and removal of the corresponding metacarpal bone. The patient insisted on keeping her middle finger on account of appearances and the result showed that this finger without any metacarpal bone back of it did not become an obstacle in the usefulness of the hand. Wound healing was prompt. A year later a tuberculous tendovaginitis developed on the dorsal side of wrist of same hand, was surgically treated. Since then (six and one-half years) there has been no recurrence of tuberculosis.

Case 2. Edward C., age 20. Tuberculous wrist of the right hand. Resection. The family history is negative. A year previously there was serious lung involvement with hæmorrhages. The pulmonary condition is now quiescent; no fever

Slight injury in form of a twist of the hand is mentioned as the beginning of the trouble. The function gradually became limited, and the hand slightly flexed. The wrist was swollen, extremely painful to touch, with no active movements; pressure on ends of ulnar and radial bones and carpus is very painful. He is unable to close the hand or straighten the fingers; he is unable to hold a pen in the hand. There is no fistula.

Through a Langenbeck's dorsal incision the diseased carpus was removed, leaving only the pisiform and multangulum majus. The ends of the radial and ulnar bones were also removed on account of caries. A splint was applied with the hand in strong dorsal flexion. Recovery was uneventful. The patient was able to hold a pen in his hand when he left the hospital 4 weeks after operation. A splint was used for another 6 weeks. After this, the hand was in useful condition and was painless.

The patient contracted a cold 6 months later, and died from pulmonary hæmorrhage.

Case 3. Mrs. Sarah L., age 50, had a tuberculous elbow of the left arm. The family history reveals no tuberculosis. The patient was formerly a strong woman, the mother of 10 children. In August, 1903, she wrenched her elbow in wringing out a

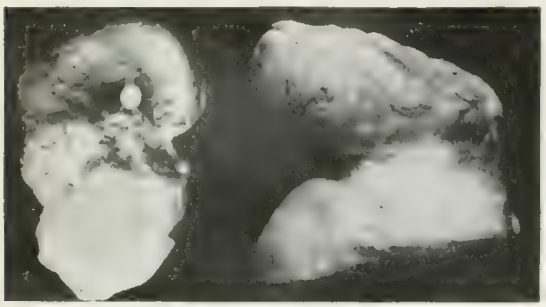

Fig. 1. Case 12. Resection of tuberculous knee-joint in Mrs. W., aged 58.

heavy garment. Since then movement in the elbow has been limited. Eight months later, April, 1904, the patient suffered a second trauma. She fell striking her elbow against a fencepost. Three weeks later a discharging fistula developed at the outer side of the elbow. The fistula closed spontaneously a few weeks later. There was a gradual increase of pain, and more marked limitation of motion.

Status. In June, 1906, she presented a much thickened left elbow, with striking atrophy of the upper and forearm muscles. Elbow at right angle; fore-arm in pronation. There was a large fistula behind the inner epicondyle of the humerus. There was only 7 degrees active motion in the sense of flexion; about 10 degrees active supination, quite painful. Pressure on the olecranon and the head of the radius was very painful; less on epicondyles of humerus.

A typical resection of the elbow through Kocher's outer incision was done July 4, 1906. There was abundant tuberculous granulations in the joint; the cartilage of the three bones was mostly destroyed. The bone-ends were carious. An irregular sequestrum of hazelnut size was removed from the middle of the epiphysis of the humerus. The bones were wired. Healing with outer and inner fistula. Result: flail joint.

A second resection was done 11 months later, June 11, 1907. There were no more granulations in the joint, but caries of humerus and fore-arm bones. Again the bones were wired. The wound healed perfectly, and has remained without fistula until today. She has an astonishingly useful joint although still too loose. She does all her house and garden work, and feels very much benefited by the operation. She has gained 25 pounds.

Cases 4 and 5 are patients with resections of the ankle-joint. In Case 4, a girl of 12 years, the immediate results on one side and six months later, on the other side were beyond reproach, but the girl died 4 months after the second operation, from meningitis.

Case 5. The other case of resection of the ankle-joint, is that of a 14 year old boy. The result was more gratifying. Here we removed the entire astragalus, in addition to the epiphyseal ends of tibia and fibula. The young man was seen 6 years later, and although limping somewhat on account of the shortening, he could walk freely without any pains.

Case 6. Viola G., age 4, presented tuberculosis of the tarsometatarsal joints. Two fistulæ existed. The little girl was unable to step on her foot. Through two side incisions we gained access to the middle of foot, removed the ends of the astragalus and calcaneus and the entire middle foot, including the base of the metatarsal bones, thus bringing the front part of the foot in contact with the heel-bone, and the astragalus. The result was a striking one, not only did the wound heal without fistulæ, but the girl who is now a young lady of 20 presented to us about a year ago a well formed and useful foot, though of course shorter than the other. She walked without limping.

Cases 7, 8, and 9 had tuberculous coxitis. Within 8 weeks after the operation they were all up and about on crutches. Having been city hospital cases we were unfortunately unable to follow them up.

Case 7, a boy of 16, had an extensive synovitis and partial destruction of the femur head.

Case 8, a girl of 13, with a previous conservative treatment of over one year, had extensive bone destruction of the head of the femur and acetabulum; the latter perforated in two places. The patient was walking on crutches 6 weeks later.

Case 9, Tilda S., age 8, had a negative family history. She was ill nearly two years. She was treated conservatively for 7 months. As the case is of special interest, a somewhat detailed report follows. She had a noticeable deformity of the right hip with a swelling above and behind. The right superior anterior spine was 1 inch lower than the left when the patient lay flat on her back. The right trochanter appeared flattened on account of the swelling. The right groin has a chain of swollen glands. Active movements in hip-joint are absent. When lifted on her feet the child cries out in agony. Examination by rectum shows a very painful region of the acetabulum and some softening.

Examination under anæsthesia: Rectal examination repeated. We recognize a distinct gland of the size of a peanut directly above the acetabulum. We find both trochanters in equal distance from the corresponding anterior spines. The right knee somewhat stiffened, is easily loosened; the joint is otherwise normal. There is a slight pes equinus. In flexing the right femur we notice a bony crepitation. Flexion of the femur up to 90 degrees and full extension are possible; rotation to about 20 degrees; abduction 5 degrees; no adduction. All this is possible in narcosis. The leg is 3 centimeters shorter than the other.

Fresh air and tuberculin treatment for about 6 weeks, precedes the operation.

Operation, October 9, 1907. Kocher's angular incision. An abscess in the gluteal region was found before incising the capsule (bursitis glutæi maximi). After the capsule was opened, we found the inflamed

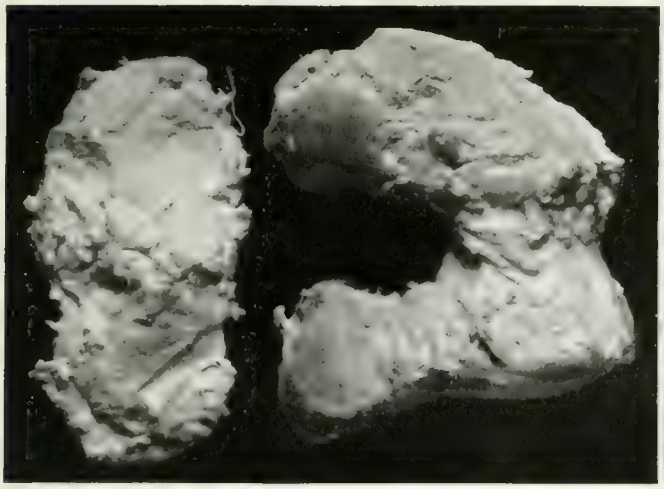

Fig. 2.

Fig. 2. Case 11. Resection of tuberculous knee-joint in Mr. A., aged 33.

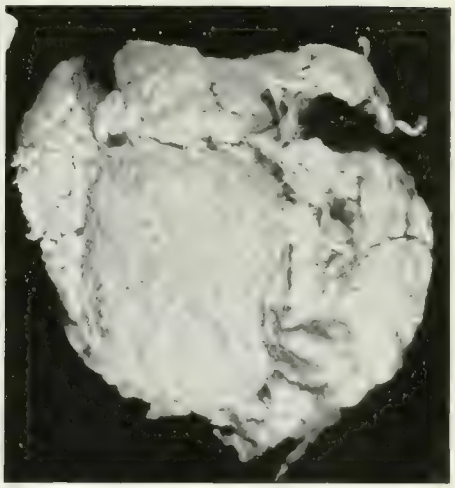

Fig. 3.

Fig. 3. Case 11. Knee-cap with tuberculous fungi.

synovial membrane thickened with granulations. The bone destruction was very marked. There was no cartilage anywhere,the socket seemed to be a good deal deeper than normal. In its middle we found a softened place of the size of a peanut, filled with granulations, evidently a perforation which admitted the tip of the little finger. There was another smaller perforation at the lower border of the acetabulum. The ligamentum teres showed partial destruction, and was therefore removed. The synovial membrane including the diseased capsule and all the carious bone tissue of the acetabulum and head of femur was carefully removed. Iodoform powder was rubbed into all the pockets, and its surplus washed away. Iodoform gauze drainage was placed in the perforation of the acetabulum and drainage established in front of and behind the head of the femur. The wound was closed in the usual way. A plaster-of-Paris cast was placed from the knees upward, including the pelvis. Both legs were extended in abduction.

Nine weeks after the operation, although, of course, the patient has a stiff joint, he walks without crutches, without assistance, and without pain.

Cases 10, 11, 12, and 13 form a group of typical knee-joint tuberculous infections.

Case 10, Lizzie B., a girl of 17, is especially characteristic for a tuberculous synovitis of the entire joint without involvement of the bones. As the case made an uneventful recovery, left the hospital in 3 weeks, remained well until now, that is for 20 years, and has retained a partial function of the knee-joint so that she walks practically without limping, it will prove to us that a primary synovial tuberculosis does exist and that here an arthrectomy with removal of the entire synovial membrane leaving the bones and cartilage intact can be of great advantage.

We proceeded as follows: Lateral, longitudinal incision, chiseling off the insertion of the patellar ligament with the tuberosity of the tibia and also detaching with a chisel the insertions of both lateral ligaments with the epicondyles, thus giving a perfect access to the joint. Contrary to the procedure of resection of the joint where the capsule is incised at the start, we removed the entire diseased capsule, as much as possible *in toto* starting on the outer side of femur, and opening the joint cavity as late in the procedure as feasible. The entire capsule was thus dissected away. The menisci were removed together with the capsule. But the cruciform ligaments were saved, requiring a careful dissection of the synovial membrane which was wrapped around these ligaments. In this way the result was a fibrous ankylosis of the joint with a partially preserved function.

Cases 11, 12 and 13 showed bone involvement of the tibia and femur and required a resection of the epiphyseal ends.

Case 11. Alfred A., age 33, was operated upon August 4, 1910, for tuberculosis of the left knee. Healing took place within 4 weeks. After this another lighter cast was applied for 2 more months. Perfect ankylosis resulted. We heard from the patient in 1917 and again now. Previous to the operation the man was unable to make a living on his farm due to the severe pains in the knee. He now writes, 9 years after the operation, that he does all his farmwork without the least discomfort.

Case 12, Mrs. Mary W., age 58, was operated on August 5, 1916, for tuberculosis of the left knee. The case is of interest because of her age. The

Fig. 4.

Fig. 4. Case 13. Resection of knee-joint for advanced tuberculosis in Mrs. A., aged 25.

Fig. 5.

Fig. 5. Case 13. Eroded knee-cap.

infection had started after trauma. The bones were less diseased than in the previous case. Healing took place with perfect ankylosis. A report from her a year later was good and exceedingly cheerful.

Case 13, Mrs. Magnil A., age 25, was operated on December 6, 1917, for tuberculosis of the right knee. The sickness extended over many years. She came to us on crutches with the knee flexed, unable to step on the foot. The long standing of the disease probably explains the extensive destruction of both bones, more so than in any of our previously mentioned cases. As the patient was a frail individual with a positive family history and having had one child, we performed 4 months later the operation for sterilization. In a recent letter she states that she enjoys excellent health.

ROLLIER'S HELIOTHERAPY.

European surgeons of late years have given Rollier's heliotherapeutic treatment for surgical tuberculosis due consideration. Men, like Bardenheuer, after personal inspection of the hospitals at Leysin, have become very enthusiastic about the treatment. De Quervain, in Berne, as a leader, advocates the view that heliotherapy applied in the sense of Rollier is taking the place of bloody operations for closed surgical tuberculosis.

We have learned that Rollier's treatment is being used, and apparently with success, at the Adam Memorial Hospital at Prysburg, New York.

For those who are less familiar with Rollier's sun-treatment, I will say that sun-rays are combined with open-air treatment at an altitude of from 3,500 feet to 5,000 feet. I can only briefly state that the body of the patient is cautiously, that is very gradually allowed to be influenced by these solar rays as well as by the open air. It is astonishing how the body, which at first is exposed to the rays for only a few minutes a day, can stand later on the solar rays for hours. Complications of the skin, headaches, and tachycardia are cautiously avoided. The skin soon becomes tanned. It changes from a light brown into a deep copper color. It is characteristic that the dark complected individual tans deeper and that his prognosis is better. The immobilization of the joints is done only when needed and then only by removable splints and extensions not interfering with the treatment.

The sun rays show their beneficial influence within days and the analgesic action is striking. Rollier's statistics show that uncomplicated, closed tuberculosis of the joints is definitely and permanently cured within 2 to 3 years with a *restitutio ad integrum.*

Fig. 6

Fig. 7.

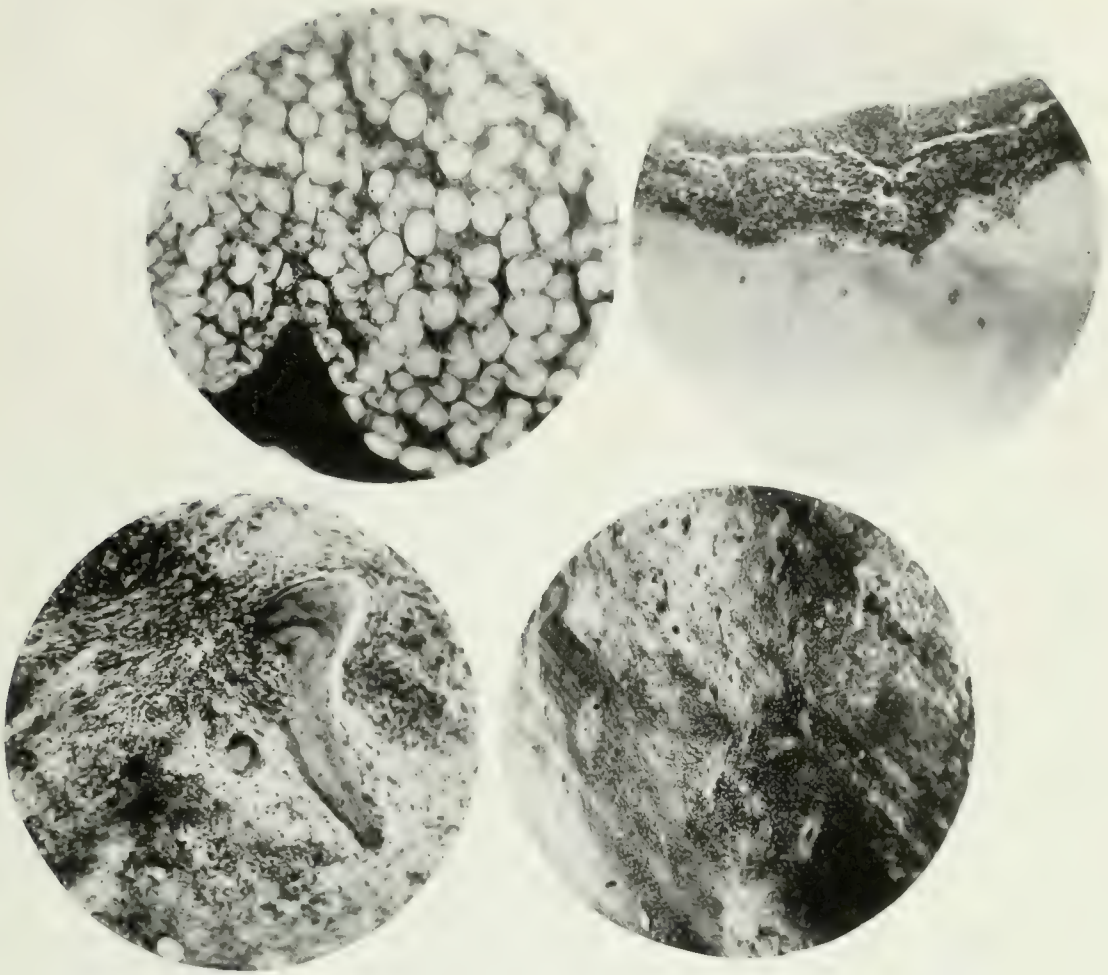

Fig. 8.

Fig. 9.

Fig. 6. Case 13. Leucocyte infiltration in superficial fat layer.

Fig. 7. Case 13. Area of necrotic cartilage.

Fig. 8. Case 13. Tuberculous osteitis, partial necrosis of bone tissue, giant cell.

Fig. 9. Case 13. Extensive bone necrosis.

De Quervain says that the treatment with the alpine solar rays for surgical tuberculosis in the human has ceased to be an experiment.

Though Rollier speaks of an analgesic, a bactericidal, and a sclerogenetic action of the solar rays, a clear understanding of the theoretic side concerning the most important points of the sun rays and their influence upon the human body has not as yet been reached. We do not know how deep the sun rays enter into the human body and we are left in the dark as to their action upon the tissue cell.

The sun rays are divided into two classes: long-waved and short waved ones. In the latter group belong the ultraviolet rays. This portion of the spectrum of the sunlight is the therapeutically active one. These rays are the cause of the pigmentation of the skin. They differ in action and influence in different altitudes. In the lower altitudes, contrary to the higher altitudes, these shorter waves (the

ultraviolet ones) are principally absorbed by the denser atmosphere that contains more dust and moisture.

It remains for us to state that Rollier is earnestly attempting to create a scientific basis for the heliotherapy. As former assistant of Kocher he does not discredit the employment of operative procedures in the treatment of tuberculosis when such measures cannot be avoided. The difficulties he encounters are the same as ours; the open tuberculosis brought on through negligence or ignorance. And if he decries opening tuberculous foci under any but the strictest aseptic conditions, we must heartily agree with him.

No doubt it would be taking another great step ahead in the treatment of surgical tuberculosis to establish numerous institutions in our country where Rollier's sun-treatment could be used intelligently. But not having the benefit of such instititions at the present time we must face the situation as it lies before us today. Granted we have the advantages of hospitals specializing in heliotherapy there may always be cases which cannot spend a year and a half to three years in such institutions waiting for a definite cure. For these patients surgery may be preferable, as the ability to work with a painless limb outweighs for them the drawback resulting from an ankylosed joint.

THE POSTMATURE CHILD[1]

By CHARLES B. REED, M.D., F.A.C.S., Chicago

THE duration of human pregnancy is not accurately known and, on account of the obscurity that shrouds the meeting of the spermatozoon and the ovule it is questionable whether this problem can ever be exactly solved. Nor is it probable, furthermore, that methods can be devised which will enable us to discover the exact moment when the division of the nucleus begins after fertilization, nor under what combination of favorable circumstances the egg begins its excavation of the decidua.

We do know, through Bossi and others, that spermatozoa may remain active and fertile in the congenial environment of the female genitalia for periods varying from 17 to 21 days, but this information contributes more to our confusion than to our enlightenment.

Fertilization also may occur as well before the first period missed as after the last period present and in view of these various phenomena there is a color of justice in the claim of some of our colleagues that such a thing as a postmature child does not exist.

While doubt as to postmaturity in the child is occasionally met with, it is quite generally agreed among obstetricians but without conceding a relationship, that prolongation of pregnancy does occur, and it is the object of this paper to point out that prolongation of pregnancy is an important factor in postmaturity; that postmaturity is exactly as serious a complication as contracted pelvis and that a failure to recognize and correct the condition is an error in art associated with great danger to mother and child.

The duration of human pregnancy has been considered carefully by von Winckel and again reviewed in a logical and conclusive paper by McDonald some years ago, but it seems desirable to reiterate some of the principal premises of an argument to which nothing of importance has been added.

Through the examination of abundant statistics and the application of the law of averages a period for human pregnancy that is physiologically adequate has been fixed approximately between 270 and 280 days. Casalis gives 276 days counting from the menstrual periods and 270 counting from coitus. Issmer practically agrees with the last figures and assigns 268.2 days after coitus, but Reid's case of pregnancy that lasted 300 days after a single known coitus again disturbs our calculations

To allow for conceptions that occur before the first period missed, the upper limit of normal gestation has been set by several authorities at 302 days and this figure has been recognized as legal in some European countries. The marked diversity of opinion may be further illustrated by von Winckel's statement that the upper boundary should be set at 334 days after the last menstrual period and 321 after cohabitation. In his opinion the calculation from the menstrual period should be 10 or 12 days longer than that based on coitus.

Such differences among expert analysts not only emphasize our lack of knowledge but they stimulate us to find other standards than the history of the case which is obviously unreliable and frequently unobtainable.

If 274 days is to be regarded as the normal duration of human pregnancy, and this seems probable, then 334 or even 302 days cannot pass without extreme danger to the mother and to the steadily growing child.

When we go to the orchard or to the factory to note the progress of fruit or fabric we consider the factor of time as a variable incident merely and we look to the product itself to determine best its ripeness or its percentage of completion. In a similar manner it would appear rational to estimate the normal duration of pregnancy by the results achieved; to measure the advance toward maturity, not by the length of time passed in gestation, whether long or short, but rather, as McDonald suggests, by the state of development of the child.

Read before the Chicago Gynecological Society, January 10, 1920. (For discussion see p. 627)

The question of fœtal maturity requires a little illumination for, while "ripeness" *in utero* cannot be ascertained with scientific precision, yet it can be recognized within such safe and reasonable limits as to satisfy all the requirements. In fact it is easier to obtain the size of the child *in utero* than the size of the pelvic inlet, and it is more trustworthy to estimate the maturity of the fœtus than to calculate the termination of pregnancy by any history, howsoever reliable. Furthermore, the duration of pregnancy must always be an uncertain event since to the obscurity that surrounds the moment of conception must be added our ignorance of the phenomena which lead to the onset of labor.

The maturity of the fœtus is a definite landmark which, if recognized, indicates that the purpose of gestation has been fulfilled; that the normal end of pregnancy has been reached, and if labor does not soon occur both mother and child will be endangered.

We submit, therefore, that since the maturity of the fœtus is the only factor in the problem that furnishes objective evidence, it should, by this token, be given the first place in all computations of the day when labor properly should begin.

If the embryologists could tell us when the embryonic type of cell is transformed into the mature type, the time element in gestation would be more valuable, but Nature makes no sudden transitions and this highly significant event remains unreported. For our purpose, however, this transformation of the cells is not really essential since it could not be recognized clinically and we have other and more practical data nearer at hand.

The mature child must have organs that have attained such anatomical and physiological perfection that they will functionate satisfactorily when called upon by extra-uterine necessities. Such organs as the stomach, intestines, skin, lungs, and kidneys, relatively quiescent in the uterus, must be able to accept and sustain the larger responsibilities of atmospheric life.

In securing this development a variable period of time must be passed in the uterus and the completion of the process is associated with the attainment of a more or less definite fœtal length and a more or less definite fœtal weight.

"The chief phenomenon of intra-uterine life," says Ballentyne, "is growth, rapid and continuous in accordance with the plan laid down in the embryo. Within 7 calendar months, which is the duration, roughly speaking of human fœtal (not embryonic) life, the organism increases from a structure 1 inch in length and weighing 1 ounce, to a body 20 inches in length and weighing 7 to 8 pounds.

The tenth lunar month of intra-uterine life, or the eighth of truly fœtal life, culminates in the attainment of maturity or the "ripeness" of the fœtus. The end of profitable intra-uterine life has been reached. In these last four weeks there is still considerable growth both in length and weight though placental activity is practically at an end.

"The length of the fœtus reaches 51 centimeters and the weight 7½ pounds, more or less. The fœtus now (at the tenth lunar month with this weight and length) has the general appearance of maturity" which is so difficult to describe but is so quickly recognized by the expert. The mature fœtus is now ready for and capable of surviving its transfer into extra-uterine life.

With such data as a base we may tentatively permit ourselves to accept Ballentyne's definition of maturity as that state or degree of fœtal development whereby the child is enabled easily to surmount the perils and aggressions of extra-uterine life.

It is now proper and desirable for labor to begin but it does not always do so. In 6 to 8 per cent of the cases (Parvin), the child remains in the uterus and continues to grow while the attendant waits for Nature to complete her uncertain and fortuitous process. He temporizes.

Having spoken so disparagingly of the long-honored time element what can we say regarding the length, weight, and other phenomena, the clinical value of which, we believe, entitles them to more respect. Ballentyne has been quoted above as fixing the length of the mature child at 51 centimeters and in this estimate he is supported by Hirst and von Hecker. Webster, Dorland, Cragin, Eden, and

Edgar agree on 50 centimeters, while Peterson, Ahlfeld, Stumpf, Williams, and Issmer are content with anything between 50 and 51 centimeters. In our own relatively small series the length varied from 48 to 53 centimeters with an average of 50.2 centimeters. All the babes were mature as we understand the term. Obstetricians are apparently harmonious in the opinion that a babe of 50 to 51 centimeters is mature, although it is a matter of everyday experience that newborn infants differ from each other in length and more especially in weight even when there is reason to believe they have passed about the same period of time in the uterus. To allow for these variations in length some authorities extend the upper and lower limits. Hirst will go as high as 53 centimeters, Ahlfeld concedes from 48 to 56 centimeters, von Hecker and Issmer from 48 to 58 centimeters, and Goenner from 48 to 54 centimeters. It is our opinion that the upper limit cannot exceed 53 centimeters ordinarily, without entering the postmature class, while babes under 48 centimeters are rarely mature except in the case of twins.

It will be noted that the length of the babe does not show such wide differences as the weight. Mature length being once attained it does not respond so readily to the nutritional impulse. Further growth in length may take place but it is difficult and increasingly resisted. It is on account of this definite stability that the length necessarily becomes more reliable as a standard of maturity. The rate of growth in the last month varies from one to one and one-half centimeters a week according to Ballentyne, while our own measurements would indicate that ½ centimeter a week was a little short of the average.

The weight of a mature child has been considered from many sides and by many writers but the results agree more closely than one would expect. Thus Hirst and Dorland set the average at about 2,800 grams (6 pounds 1½ ounces). Edgar, Webster, Eden, Goenner, Cragin, Jewett, Stumpf, Williams, Ahlfeld, and McDonald accept from 3,200 grams to 3,300 grams (7 to 7½ pounds). It is not unreasonable, therefore, to put the average weight of the mature fœtus at from 6 pounds to 7¼ pounds (2,800 grams to 3,300 grams). However, American babes may weigh so little as 5½ pounds (2,500 grams) or so much as 9 pounds (4,000 grams), and still be within the limits of maturity.

The factors of fœtal nutrition are so numerous and their relations so intricate that it is impossible at present to obtain the co-efficient. It follows that all the elements of fœtal growth and especially those that are instrumental in the production of a large, not to say postmature child, are not demonstrable. Many explanations have been offered to account for that continuance of development which assuredly occurs so long as the child remains in the uterus. Among these influences may be mentioned the age or the size of the parents, the parity of the mother, whether she is married or single, the duration of the menstrual flow or the commencement of her reproductive life, her general health, social state and food supply or her conditions of rest or activity during gestation, the sex of the fœtus, and paternal inheritance. One or all of these conditions may or may not be potentially present. It is evident, however, that as the child reaches maturity *in utero*, organ formation practically ceases and only minor changes in shape and visceral relationship occur after birth. The purpose of the pregnancy is now fulfilled, and if labor does not soon occur one of two things must happen; either the babe dies *in utero* and undergoes the usual postmortem changes, or the nutritional impulse is extended and the child puts on weight. The additional weight consists almost wholly of fat and water.

By reason directly of the prolongation of the pregnancy, the child now becomes postmature according to the terms of our definition of maturity. Weight and length increase but especially the weight. As we have stated elsewhere, the deposit of fat in the babe, as in the adult, demonstrates that the intake of nourishment is not fully consumed because the normal limits of metabolism have been overstepped and in consequence the unusable material must be stored up. The child, normal in size and organically perfect, is forced to an abnormal growth through the unaccountable delay in uterine activity.

The point where this postmaturity usually begins may be set arbitrarily at 4,000 grams or 9 pounds, but there are exceptions. We must not forget that some babies which have passed more than the average gestational period in the uterus are lighter in weight than others that have not yet approached that movable boundary. Blau and Cristofoletti found 15.5 per cent of babes weighing from 6 to 9 pounds among pregnancies that lasted more than 300 days.

Nevertheless large fat babies are usually associated with prolongation of pregnancy and von Winckel claims that 71.8 per cent of all babes weighing more than 8½ pounds (3,600 grams) are postmature.

Many reasons have been assigned for the postponement of labor, but none of these can be satisfactory until the etiological factors in the inauguration of uterine activity at a given time have been explained.

Our own cases of large fat babies have been practically always associated with large placentas that weighed from 1¼ pounds to 2 pounds and we have come to regard this condition as customary. Whether the large placenta plays an important part in delaying the onset of labor we do not undertake to say but certainly it is physiological that a large placenta should be indispensable to the proper nutrition of a large child.

The child that has become overlarge through the prolongation of pregnancy shows an abnormal increase in the deposition of fat, as we have stated earlier, and exhibits tissues that are swollen by the infiltration of fluid. Ballentyne states that the proportion of fluid may be as much as 74.4 per cent of the entire body weight, and that a large amount of fat is deposited under the skin during the ninth and tenth months which at term amounts to 9.1 per cent of the body weight.

A certain amount of this fat and fluid is necessary for the support and sustenance of the babe during the milkless interval before the breasts fill. but an excess of such material is not only unnecessary but it is objectionable as a hindrance to organic function.

Fortunately both the fat and the fluid are quickly squeezed out of the child after birth. The heavier the babe, the greater and the more rapid the loss. In our series the babes that averaged 7 pounds lost 8.5 ounces in two and one-half days and then gained, while babes that averaged 9 to 10 pounds lost 14½ ounces in 3 days and then gained.

Obviously there is no particular advantage in the large fat babies about which we hear so much, since the tissue is so soon lost. Its presence is merely an indication that the end of profitable intra-uterine life has been passed over and that the postmature child has really spent time in the uterus which should have been spent in becoming accustomed to its new atmospheric environment.

The size of the fœtal head is the third objective point on which our diagnostic tripod must rest.

Von Winckel gives the average occipitofrontal diameter in the mature fœtus as 12 centimeters and the biparietal as 9.25 centimeters. Hirst gives practically the same figures. In our own series we found the occipitofrontal diameter of mature babes to measure from 10 to 12 centimeters and the biparietal to vary from 8.5 to 10 centimeters. The other diameters would be highly important but we cannot get them on the unborn child. Mature babies may exhibit diameters both larger or smaller than von Winckel's figures, but the postmature child will show a positive increase in all the diameters without disturbance of their proportion to each other.

To recapitulate it would appear—

1. That the actual duration of pregnancy has not been established and while the period has been closely estimated, it can never be more than an approximation.

2. That gestation is frequently abbreviated or prolonged unaccountably.

3. That the prolongation of pregnancy is a definite factor in the production of the postmature child.

4. That postmature babes are usually, though not necessarily, large and fat and weigh 4,000 grams or more.

5. That probably 6 to 8 per cent of pregnancies are for some reason prolonged (Parvin) and that 71.8 per cent of all babies weighing over 4,000 grams are postmature (von Winckel).

6. That a possible etiological factor may be found in the large and functionally strong placentas that are usually associated with large babies.

7. That large babies lose much weight rapidly and, therefore, possess no advantage over smaller ones.

8. That fœtal maturity is safer and more certain than the menstrual history, the date of a known coitus, or the date of quickening, as a basis for the calculation of the proper end of gestation.

9. That fœtal maturity, although fundamentally bound up with organic perfection, is really associated with reasonably stable objective characteristics of which the most important are the length, the weight, and the *fœtal head diameters.*

DANGERS

For the sake of completeness we must next refer briefly to the dangers, familiar to all of you, which hover about the birth of a large or postmature child. As soon as the weight of the child passes 4,000 grams, the difficulties in labor tend to become serious. The duration of the process, its termination, and its prognosis are definitely influenced. In reality it is not so much the weight of the babe as its volume; a bulkiness that may be due to fatness or huge shoulders, but there is especially a lack in conformability of the head that complicates the delivery. As a rule, however, it will be observed that the dimensions of the head increase in direct proportion to the weight. Furthermore, the bones of the head are dense and unyielding. They do not mold. The flesh is firm and inelastic, and the child advances only at the expense of an enormous overdistention of the parturient passage.

On account of overdistention of the uterus, the membranes rupture early and the large head does not easily engage. A long, slow, exhausting labor ensues which predisposes to infection of the mother through diminished immunity and the decomposition of the secretions of the birth canal.

On the other hand, if the pains are violent, rupture of the pelvic joints or rupture of the uterus may occur while lacerations of cervix, vagina, and perineum are more frequent than usual. Fistulæ into the vagina from bladder or rectum will follow the long continued pressure on the tissues.

Maternal fatalities may develop in the course of injudicious efforts to aid the delivery by version or high forceps while postpartum hæmorrhage must be expected in consequence of the overdistention which predisposes to weak contractions, imperfect placental separation, and poor uterine retraction.

The postmature child may perish before labor comes on, and during labor it is threatened with intra-uterine death through shrinkage of the blood supply, by strangulation at the vulva, by the pressure of a tightly retracted perineum and by cerebral compression, as well as by operative injuries. Asphyxiation, intracranial hæmorrhage, fractures of the skull, spoon-shaped depressions, hæmatoma, paralysis of face or shoulder may occur while the possible termination of the labor by craniotomy, cleidotomy, or evisceration completes the picture.

We say that a postmature child is exposed to the above injuries, but the question naturally arises, if we do not know the duration of pregnancy, how can we assert that it is prolonged and, if we do not know what constitutes maturity, how can we claim that a child is postmature?

When after repeated examinations the obstetrician is assured that the child is sufficiently mature according to our definition to carry on extra-uterine life easily then there is no need for the pregnancy to be prolonged further. This condition of the fœtus may readily eventuate 2 weeks before term, or exactly at the fortieth week, or again if the child be small it may be advantageous for the pregnancy to continue beyond the fortieth week, if possible. The condition of the child is determined by the—

DIAGNOSIS

The most conspicuous features of maturity must be sought, as we have stated, in the perfection of the various organs and in the length and weight of the fœtus and diameters of the fœtal head. The length and weight of

the babe and *some* of the diameters of the head are the only characteristics which can be determined by external measurement, and therefore the ones upon which a diagnosis of maturity *in utero* can rest. Fortunately they are sufficient.

Length. The length of the child can be obtained by means of the familiar method of Ahlfeld. In our series the antepartum measurements tallied exactly with the postpartum findings in 37 per cent, varied 0.5 centimeters or less in 24 per cent, and less than 1.5 centimeters in 29 per cent. None of these differences is great enough to interfere seriously with the diagnosis. We regard it as a procedure of extreme diagnostic value. Its simplicity is also a recommendation. One tip of the pelvimeter is placed under the upper fold of the genital crease and pushed upward until it rests on the upper edge of the symphysis. The other tip is placed on the most distant point of the opposite pole of the child (head or breech) which has been located previously. From the scale reading deduct 2 centimeters to allow for the thickness of the abdominal walls and multiply the result by 2. The product is the length of the child.

Size. The size of the child is merely another name for the weight. This information is obtained by means of McDonald's manœuver, which measures the height of the fundus. Varnier, Spiegelberg, and others from observations on large masses of material have stated that the fundus uteri should be 33 centimeters above the symphysis when it contains a mature child at term.

McDonald takes 35 centimeters as the standard and predicates that this height is attained when the uterus holds a mature babe of 3,300 grams (7⅓ pounds). The weight of the child is increased or diminished by 200 grams for each variation of 1 centimeter in the height of the fundus. We have not been disappointed in the use of this procedure, so far as concerns maturity. The weights, however, do not always conform to the antepartum estimates.

The *diameters of the fœtal head* are last in order though not in importance. These measurements are obtained by Perret's method which takes the occipitofrontal diameter directly and derives the biparietal from it by deductions which have been worked out on a scale of variables.

Perret planned at first to measure the occipitofrontal diameter as it lies across the pelvic inlet and then deduct 2.5 centimeters to get the biparietal. The results were not as reliable as could be wished. Next, Stone advised the omission of an allowance for the thickness of the abdominal walls. McDonald recognized that the biparietal must vary as the occipitofrontal varies, and devised a scale of deductions which, with a trifling addition, we have employed in our series. The scale follows:

To obtain the biparietal diameter from the

	Centimeters	Centimeters
Occipitofrontal of	12	deduct 2.5
Occipitofrontal of	11.5	deduct 2.25
Occipitofrontal of	11.25	deduct 2.0
Occipitofrontal of	10.5 to 11	deduct 1.5

The occipitofrontal poles are engaged between the tips of the fingers by deep pressure into the inlet on both sides of the pelvis. An assistant then measures the distance between the ends of the finger tips with the pelvimeter. The result is compared with the scale, and the deduction being made the biparietal is found.

In our series the measurement of the occipitofrontal diameter antepartum tallied exactly with the postpartum control in 40 per cent. It was within 0.25 centimeter in 34 per cent; within 0.5 centimeter in 24 per cent; and varied by 1.0 centimeter in 2 per cent.

The biparietal obtained from the above measurements was exactly the same as the postpartum findings in 36 per cent, within 0.25 centimeter in 31.7 per cent, 25.8 per cent were within 0.5 centimeter and the remaining five within 1.0 centimeter. McDonald's results were even better.

It should not cause discouragement if, in some cases, the relationship of the biparietal and the occipitofrontal should not conform postpartum to the antepartum estimate, for it has been shown that while these proportions are stable in normal cases and in those de-

livered by cæsarean section, there is a marked discrepancy where the head has passed with slowness and difficulty through the birth canal. In all the cases where the head was molded, Ballentyne found a diminution in the occipitofrontal, occipitomental, and suboccipitobregmatic diameters. In heads that pass the pelvis without forced conformation the interrelations of the diameters are not affected.

In our work at Wesley Memorial Hospital, we rely almost entirely on the results of the above three procedures, corrected and checked, of course, wherever possible by the menstrual history and the date of quickening. In hospital practice, however, the menstrual history and date of quickening are unreliable even when known, and we have come to give them a place of very minor importance.

Our experience with the methods described has been gratifying, and we feel confident that they will enable the attendant to recognize most cases of mature babes as we have defined and described them and all cases of postmaturity. Abdominal walls that are unusually fat or muscular, or distended by hydramnios may cause confusion, but these conditions are rare. Twins may complicate or delay the diagnosis, but the patient is not imperiled. Furthermore, the examinations are all external and the danger of infection is not to be feared.

In our experience, the estimation of fœtal size and head diameters is far more reliable than the appreciation of the pelvic diameters by the customary procedures.

TREATMENT

When diagnosis of maturity or postmaturity has been made what shall we do? It is too late to influence the size of the child by Prochownick's diet except in those rare cases of habitual postmaturity described by Moisnard. Here perhaps the conditions could be anticipated.

The principle of management must be based on the results of regular and painstaking examinations of the child with a merely subsidiary interest in the subjective history.

If the child is mature and the pelvis not seriously contracted, several days or a week may be permitted to elapse, and then if Nature fails in her duty, a day should be set and the labor induced.

The induction may be brought about easily, safely, and expeditiously by castor oil and quinine, or by the Voorhees bag, or by both. Castor oil and quinine is effective in possibly 2 cases out of 5 but the Voorhees bag is always highly dependable.

If the attendant has not been watchful or if through the weight of tradition he has allowed the child to become postmature, a careful revision of the pelvic diameters must be undertaken. This examination may show that the transit of the child through the maternal passages would be highly questionable and possibly accompanied by more than ordinary danger. In such a case the cæsarean operation will suggest itself as the most conservative way of terminating the pregnancy.

On the other hand if the delivery by the pelvic route seems feasible, even though difficult, labor may be induced by the bag with a reservation that if the natural powers are insufficient, delivery may be completed by version and extraction or forceps, depending on the conditions and preceded if necessary by pubiotomy.

To foresee difficulties that impend and to anticipate them by proper and judicious means is called by rhetoricians a "prolepsis." To foresee the obstacles and dangers which attend and follow the birth of a large or postmature child and to avert them by intelligence and skill is good obstetrics. Unhappily or otherwise we all have an ingrained reluctance to intervene in the course of what is apparently a regularly advancing pregnancy. It is much easier to let the business slip along under the impression, born of our hopes rather than of our knowledge, that by watchful waiting the problem may solve itself. Being loth to act we temporize.

"Watchful waiting," has been a popular phrase which was first used, as we recall, by Dr. Jaggard of Chicago, to discourage the attendant in those days of imperfect asepsis from unwarrantably interfering with the course of a pregnancy or labor. It was a valuable precept in its day, and doubtless

saved many lives. But the tendency of the maxim has been to excuse the timid and exonerate the indolent. The possible breadth of its application involves a larger element of danger than the condition it was designed primarily to avert. It certainly favors the occurrence of the postmature child.

We believe that more attention should be paid to the objective evidence furnished by the child *in utero*, and if this were done and generally taught the postmature child would appear less frequently and the large child would lose much of its present questionable distinction. Every case of pregnancy should be individualized without dependence upon hazy half truths or the laws of probability. Let the child affirm and the pelvis declare the anatomical gospel.

This is an epoch of clean surgery wherein *laissez faire* methods are justly looked upon with alert discrimination. Let us give to pregnancy and labor, therefore, their full significance and let us bring to the mother and child all the advantages and the fullest protection of a clean and prudent prolepsis.

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SHORT UMBILICAL CORD[1]

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THIRTY-TWO years ago, in January, 1887, John Bartlett presented to this Society a paper on dystocia caused by malposition of the cord, reporting a case where the cord was coiled four times around the neck of the child. This was discussed by Jaggard, Knox, Miller, and others. In 1902, as many of you will remember, Stowe presented a paper on rupture of the umbilical cord relating two cases, discussing the subject of short cord and giving the results of his valuable experiments in determining the tensile strength and elasticity of the funiculus. Tonight I wish to report a case that is a fairly typical example of an accidental short cord.

Mrs. H. L., I-para, age 27, Russian Jewess, married. The patient had a deep scar on the thigh due to a sword cut received during a pogrom when a child of 5. Her menstruation began at 14, and was of the 28–3-day type, moderate in amount and associated with some pain. Her last menstruation was on February 3, 1919, conforming to labor November 10. Pregnancy was normal. Her external pelvic measurements were: interspinal 25.2, intercristal 27.8, Baudeloque 20. The conjugate diameter was normal. Labor began November 16, 1919, at 7 p.m., with irregular moderate pains lasting to 40 seconds. External examination disclosed the head in the inlet, position back, right, posterior; heart tones 130 in right lower quadrant. The first internal examination was made at 8.10 a.m., November 17, and showed the os dilated 1 finger and membranes intact with head *in aditu*. The contractions were fairly good during the day and not very painful. No region of the uterus was especially tender and there was no sign of depression of the fundus or of any other area. A second internal examination at 4.20 p.m. showed the cervix was effaced and thin with the os 1½ fingers dilated. On the 18th, the contractions continued to be moderate in strength, lasting about 45 seconds and coming about every 5 to 7 minutes. The membranes ruptured about 1 p.m., a small amount of liquor amnii escaping. An internal examination showed the cervix soft with the os dilated about 3 fingers. The head was still *in aditu* and the position was right, back, anterior. Another internal examination, the fourth, at 4.20 p.m., showed no change. The fœtal heart tones ranged between 134 to 146. The patient received during the day in all 5/16 of a grain of morphine sulphate, which was enough to relieve her pain. On the next day I examined her for the first time in the clinic and found the cervix one-third dilated with a thick rim. The head was in the excavation. The fœtus was in good condition and the heart tones about 140 per minute. As the mother was in good condition with normal temperature and pulse and as the slow labor was attributed to slow dilatation of the cervix, it was decided after considering the objections to interference to allow the labor to continue, of course, watching the mother and fœtus very carefully. The fœtal heart tones were counted and recorded every 15 minutes. During this day 5/16 of a grain of morphine sulphate and 1/100 of a grain of scopolamine were given and kept the patient fairly quiet. On the following day, November 20, at noon I found the patient beginning to show signs of exhaustion with some increase in the pulse but no increase in temperature. For the first time there was a slight show of meconium and the fœtal heart tones were somewhat irregular, between 146 and 160. An internal examination showed no change since the examination 24 hours before. The patient was anæsthetized with ether, a deep incision made anteriorly and posteriorly in the cervix and forceps applied. As the head was brought to the perineum an episiotomy was made and the head extracted. During the extraction the cord, which was coiled twice around the neck broke about 10 centimeters from the umbilicus. The entire length of the cord was afterward found to be 43 centimeters. The child which weighed 7 pounds 2½ ounces was somewhat asphyxiated and resuscitated in the usual manner. A considerable quantity of discolored fruit water followed the child. The placenta was expressed from the lower segment and the cervical and vulvar incisions were repaired. The membranes were torn near the center showing a high implantation of the placenta which, from the previously observed direction of the round ligaments, was probably attached to the left anteriorly. The cord which was of average thickness was attached not very far from the center of the placenta. It may be added that the mother, the day after the labor, had a temperature of 101° which then became and remained normal. The milk secretion was slow in appearing and the baby as the result of deficient nourishment lost about ¾ of a pound in weight, but later gained and left the hospital with the mother on the twelfth day weighing about 2 ounces less than at birth.

After birth, measuring with a tape line, the distance from the navel of the child twice around its neck to the clavicle was 56 centimeters. As the cord measured only 43 centimeters in length and

[1] Read before the Chicago Gynecological Society, January 16, 1920 For discussion see p. 622.)

had to reach to the placenta it is evident that the umbilicus must have approximated closely to the neck of the child and the cord stretched considerably. It is also evident that the chest of the fœtus must have been held close to the insertion of the cord in the placenta. Considering the nearly central rupture of the membrane and also the fact that the cord was inserted quite a distance from the edge of the placenta, the insertion of the cord must have corresponded to a point in the uterine wall more than 15 centimeters above the internal os or considerably more than the vertical diameter of the head. Consequently the head could not have exerted much pressure on the cervix nor could it serve well in the mechanism of the dilatation of the lower uterine segment. This might account in part for the very slow progress after the rupture of the membranes.

Could the holding back of the head account for the slow dilatation before the rupture which did not occur until 42 hours after the beginning of labor? While there was less than the average amount of liquor amnii, nevertheless a fair bag of waters was formed. The dilatation of the cervix depends upon the nature of its anatomical structure by virtue of which some of its fibers are pulled up into the corporal wall. There is much variation in the dilatability of cervices. In apparently normal paræ with unruptured membranes and normal fœtus and with fair uterine contractions we not very infrequently have an opening period of 40 or 50 or 60 hours. I am in the habit of explaining this fact by assuming a poor dilatability of the cervix. It seems to me that we may in this case also assume such a structural anomaly to account for the slow progress before the rupture of the bag of waters.

There was no obstruction in the bony pelvis that prevented descent. As recorded, the head, with the uterus of course, descended into the excavation in the last 36 hours of labor.

Our chief interest is naturally in the problem of diagnosis as determined by the symptoms and findings. My experience in diagnosing an absolutely or relatively short cord has not been encouraging. I have had two cases of absolute short cord, one terminated with forceps, when cutting of the cord seemed desirable to permit the birth of the body. I have had a few cases where the cord which was coiled around the neck of the child had to be cut to allow birth of the body. In none of these cases was the diagnosis made before the birth of the head.

In this case the usual symptoms were absent or not prominent. There was no special tenderness in any region of the uterus and no retraction of any part of the uterine wall during contractions. There was no hæmorrhage due to partial separation of the placenta. As the head had not escaped from the uterus there was no recession of the head from the vulvar outlet. No funic souffle was heard, although perhaps 100 examinations were made during the labor to control the condition of the fœtus. It must be admitted, however, that no attempt was made to listen during contractions and hence the intermittent souffle mentioned by Halzbach as found during contractions and due to tension on the cord may have existed. As the head was still in the uterus the condition was probably not present for the intermittent urination described by Brickner. At any rate this symptom was not observed. There were in short no symptoms of short cord except very slow dilatation of cervix and prolonged labor.

The suggestion of Haake did not occur to me; to examine through the rectum for the coils around the neck of the child. This would not have been possible, of course, during the first 3 days of the labor before descent.

In regard to treatment I only wish to remind you of the recommendation of King that advantage be taken of posture in the management of these cases. His special attention to this subject and his enthusiastic advocacy of postural treatment makes its trial desirable. Of the various reasons given to explain the advantage of a sitting or squatting posture the most probable seems to be that it favors descent of the uterus and so brings the point of the insertion of the cord nearer the outlet of the pelvis. This posture might likewise have favored dilatation in my case. The obstetrical chair lately reintroduced into our armamentarium by Markoe might serve our need here. The simplest method would be to let the patient sit up or kneel or squat in bed.

If after the birth of the head the expulsion of the body is rendered impossible on account of relative shortening of the cord by coiling around the neck, it is only necessary to clamp and cut the cord. Any attempt to release a coil and pull it over the head may prove harmful or dangerous by separating the placenta. This is one of the important reasons for the adoption of Schultze's rule to make no attempt to release funicular coils during labor.

TYPES OF PELVIC INFECTION[1]

By THEODORE J. DOEDERLEIN, M.D., Chicago

THERE are few subjects in gynecology written about and discussed as much as pelvic infection in the female, and I bespeak your forbearance for introducing this trite and time-worn topic for your consideration. However trite it may be, there probably is no other preventable disease as much sinned against as this one. Ninety per cent of all cases of female invalidism and morbidity, not speaking of the fatal cases of puerperal sepsis, are due to preventable causes. Dr. Davis, in a paper recently read before this society, pointed out that in the last decades there is little, if any, decrease in the death rate of childbed fever. Brock, in the August number of the *Lancet* writes: "To gauge results by hard figures is to admit the comparatively small reduction in mortality rate of puerperal sepsis." V. Bonney in the *Medical Press*, 1919, says: "The chief causes directly and indirectly attaching to pregnancy and labor rank in importance as follows: (1) sepsis, (2) pregnancy toxæmia, (3) hæmorrhage, (4) embolism and sudden death. Sepsis accounts for between 30 to 35 per cent of the total number of deaths." The chief medical examiner of one of our large life insurance companies upon my inquiry wrote to me that he was inclined to believe that deaths from puerperal sepsis were decreasing. He admitted, however, that statistics from insurance reports were unreliable, because pneumonia and other intercurrent diseases were listed as "childbed."

All these statements comprise the fatal cases of puerperal sepsis only. The vast number of cases of parimetritis and perimetritis, salpyngitis, oophoritis, productive of chronic invalidism and morbidity come to our notice in their severest phases only. Many of the milder cases undoubtedly drag through life unobserved and unrelieved.

In the young the vagina is sterile. Contamination may occur through baths and oilings. These bacteria, including the staphylococcus pyogenes albus, aureus and citreus, are usually entirely innocuous. It is generally known, that bacteria lose their virulence and are not as numerous the nearer one approaches the cervix. Recently I have taken cultures from various parts of the vagina of specifically infected women. As the disease abated the gonococcus disappeared first at cervix and was to be found at the introitus long after the vagina had been found free. The reason for this seems obvious. As the tissues regain their health, the normal flora, especially the bacillus vaginalis, resumes its activity, resulting in the destruction of the virulent bacteria experimentally introduced. It is assumed that the accidifying action of the bacteria has this germicidal effect. Menge differs from this view. Whatever it may be, we know that anything removing or interfering with the natural flora of the vagina, as frequent douches, strong antiseptics, the alkaline leucorrhœal discharge, cervical erosions, the menstrual epoch, predispose to pelvic infection. Strogonoff found that there is an increase of abnormal micro-organisms in the vagina preceding and following menstruation.

Generally speaking one may say that in cases of pelvic infection, bacteriology is of little value as to the course of treatment to be pursued. A streptococcus may be highly or mildly pathogenic. Hæmolysis is not an inherent attribute of any streptococcus, but it is acquired and may in turn be lost. Saprophytes, including the bacillus coli may attain fatal virulence. There also may be an important factor lying in the anaphylaxis of certain patients toward infection.

For convenience the whole subject of pelvic infections may be classified into two types; the ascending, or infection through natural channels, and the decending, or blood stream and contiguity infections.

The vast majority of infections is of the ascending type and of these we again have two types of overwhelmingly frequent occurrence; namely, the puerperal and the gonorrhœal.

[1] Read before the Chicago Gynecological Society, January 10, 1919. (For discussion see p. 628.)

Puerperal infections are wound infections. The wound may be a small tear in perineum or cervix, any abrasion in the vagina, the large wound of the placental site, a wound caused by a curette, sound or finger-nail, or any other instrument including a penholder or hairpin. In 90 per cent, the infection is introduced by the surgeon's or midwife's fingers or instruments. As Trousseau first points out, the infection enters the parametrium by way of the lymphatics and veins causing thrombophlebitis and adenitis; also infiltration of the cellular tissue surrounding the cervix inside of the broad ligaments, causing what Virchow first called parametritis, a distinctly extraperitoneal or retroperitoneal disease. Rarely this type of infection extends along the mucosa into the tubes. Usually tubal infection takes place indirectly through parametrial lymphatics.

Of considerable interest in this connection are the painstaking studies of Moritz, published in the *Journal of Obstetrics and Gynecology of the British Empire*, in 1914. He shows that the subperitoneal cavity and the base of the broad ligaments, filled up in the fœtal state by a cellular matrix of undifferentiated mesoblasts, loses its fat and becomes a dense fibromuscular tissue with fixed and definite directions along the branches of the uterine arteries for which they form a dense perivascular sheath. This tissue, known as the parametrium, consists of superimposed layers of unstriped muscular bands running into the uterus and outward, forming sheaths for the obturator internus and coccygeus muscles. The parametrial tissue is densest opposite the lower segment of the uterus and the entrance of the vascular supply of this organ. So this part, as it were, is the pedicle of the uterus. Bearing in mind this anatomical condition, we better understand the brawny inflammation around the cervix, the phlegmon ligneux, a wood-like induration around the cervix.

A case I saw with a younger colleague illustrates this type of inflammation as also the treatment to be avoided. Four weeks after an abortion she had a temperature ranging between 100 and 102°, a mucopurulent discharge, and board-like infiltration surrounding the cervix. I urgently advised against operation which was seemingly attractive to the husband and attending physician. Two weeks later I was asked to see the same patient in a hospital. She had been operated upon by her physician, the tubes and ovaries had been removed, and the patient was now in a fearfully septic condition. She survived, but her recovery was much more protracted than it would have been in all probability, without operation. With an understanding of the parametrial anatomy and the avenues and localization of the infection, it is readily seen the immense traumatism the above stated operation inflicted. This case should not have been operated upon until all acute symptoms had subsided at least 3 to 4 weeks and then, in my opinion, not without some definite indication.

Simpson tabulates the time for operation in such cases as follows: (1) The patient shall have recovered from her acute illness and shall have regained a satisfactory margin of reserve strength. (2) The temperature shall not have risen above normal for at least 3 weeks. (3) There shall have been no marked or persistent rise of temperature following a careful bimanual examination. (4) The inflammatory exudate surrounding the focus of infection shall have been completely absorbed.

In the above stated case nature's effort to localize the infection by choking the afferent lymphatics was frustrated very effectually by the treatment.

There is the other extreme of allowing too much time to elapse before such foci containing virulent bacteria, usually streptococci, are removed. Complete organization between cyst walls of ovaries, pelvic peritoneum, and contiguous organs will have taken place, necessitating extensive wounding of tissues, removal of diseased organs, and separating of adhesions. To illustrate this I wish to cite two very instructive fatal cases.

A patient, afflicted with the ordinary symptoms of female trouble, came for operation. She had had a puerperal infection 9 years previously. Her ovaries consisted of large cysts firmly bound down and matted together with intestines, omentum, and tubes. Owing to complete organizations of the adhesions it was very difficult to separate the organs. The cysts broke before removal. Although more than

ordinary care was exercised to wall-off the peritoneal cavity and establish ample drainage, the patient had a temperature of a 105° on the second day and died of violent peritonitis the fifth day. The infection was purely streptococcal.

The other case had had a pelvic cellulitis of the phlegmon ligneux type for 6 weeks. She still had a temperature and wood-like induration around the cervix. Six weeks later, 12 weeks after infection, the temperature remained normal, the exudate had disappeared, and she was sent home with instructions to come back for examination a year later. She came and an operation was deemed necessary. The adhesions, were so extensive, that on opening the abdomen no female organs could be seen until actually dug out. One ovary and tube were left, because, if at all possible, the patient could have offspring. A Gilliam suspension was made. Without much peritoneal re-action the patient recovered, went home and, as if pre-arranged, conceived. Her labor was normal but was followed by a high temperature. I was called to examine the patient and found a large cyst on the side on which the ovary and tube had been left. The next day the attending physician notified me that the cyst had broken. The patient died of violent peritonitis.

These cases teach, first, that highly virulent bacteria may become encysted and, retaining their virulency, may remain dormant for many years; second, that late operations in cases of encysted streptococcic infections are more dangerous than a judiciously chosen earlier time; third, that in spite of the most intense puerperal infection, with roofed-over pelvis and general adhesions, the generative organs may remain undisturbed, unlike the condition found in gonorrhœal infection, gonorrhœa being a past master at destroying or, at least, incapacitating the organs.

The other ascending infection generally met with is gonorrhœa. Gonorrhœa of vulva and vagina is a menace to the community including the unborn child, the glands of Bartholin often hiding gonococci for months, even years. Gonorrhœa of tubes and ovaries is a menace to host, rarely as to life, but almost always as to her reproductive functions. A vaginitis of any severity is present only in the young. Endocervicitis, found in 90 per cent of cases, is started by endotoxines, producing ectropion and eventually a pseudo-adenomatous area with infected Nabothian follicles. Saenger would point out this folliculitis in young women as pathognomonic and apply 50 per cent solution of chloride of zinc.

There are two barriers to the ascent of gonorrhœa, namely the internal os and the ostium uterinum of the tube. The gonococcus has no motility, it spreads by surface growth or by deportation. Conditions favoring ascent are, first, menstruation; second labor; third coitus; fourth digital or instrumental examinations of vagina or uterus and meddlesome treatment with douches and instrumental applications.

Mild tubal infection may permit conception. It remains latent until labor ensues, when an awakening of the dormant foci causes complete sterility. We all have had cases of labor followed by salpyngitis or perimetritis, although no vaginal examination had been made. These are cases of latent tubal gonorrhœa. The possibility of a mixed infection, of course, exists.

Summing up and contrasting the two types of infection I would say the following: Puerperal infection is dangerous to life, both immediately and remotely. I appreciate that many streptococcic masses are found self-sterilized; usually, however, they are a menace to the life of the patient at all times during their presence in the pelvis. Gonorrhœal masses are always tubal. Gonorrhœa confines itself as a rule, to an organ which it seeks to destroy. Operations for gonorrhœal pelvic infections, even with a large amount of pus, are always safe, of course, relatively speaking; recovery is prompt and without peritoneal reaction, if one is able to remove pus pockets. Crossen, in his discussion of Simpson's paper quoted above, says that he depends on two things in his differential diagnosis; on location of lesion and history of case. Where location is tubal and the history points toward gonorrhœa the case may be operated upon any time after subsidence of acute symptoms. Where lesion is parametritic and history points to puerperal septic infection, abdominal operations are dangerous at any time.

The acute state of these infections, whether parametritis, caused by the streptococcus, staphylococcus or pneumococcus or the bacillus coli, or whether a salpyngitis or parametritis of gonorrhœal origin, I have treated for years simply with absolute rest in bed with

the patient lying on her back and being lifted with care onto the bed-pan, and with ice, opium, external douches, and wet packs as needed. No meddlesome treatment is given with the hope of killing germs. My first and only vaginal examination is careful and gentle, and even this may occasionally start trouble, giving rise to a return of chill followed by fever.

This negative treatment I employ not only in acute gonorrhœa or puerperal pelvic infection, but also in cases of septic abortion with retained placenta. My rule in the care of septic abortions might be formulated as follows: The course of treatment is the reverse of what ordinarily is accepted as proper, the more virulent the type of infection, the less aggressive and meddlesome the treatment; the milder the type of uterine infection, or in the entire absence of infection, the more one may be inclined to hasten matters by emptying the uterus. Some years ago Dr. Ries presented a paper on this subject. It was to the amazement of some of his hearers that he stated that he would leave a foul-smelling, pus-laden placenta undisturbed and get good results. Since then I have followed this line of treatment.

The other type of pelvic infection, however rare, still to be considered in differential diagnosis, is the descending type, which originates by blood stream or contiguity. This type of infection is best elucidated by a case I had occasion to observe through many years.

About 18 years ago I examined a girl of 8, who had a severe pain in the left groin, a tender resistance reaching about two fingers' breadth above Poupart's ligament, and a temperature of 102 to 103°. On rectal exploration a parametrial induration could be made out. The history of the case stated, that the little girl wetted herself at school and sat in her wet clothes all day. The fever, pain, tenderness, and mass disappeared in the course of a few weeks. A blood examination was not made. The patient through these years complained of occasional attacks of pain. About a half a year ago I again examined her *per rectum* and found evidences of an old parametritis with the uterus more or less fixed and drawn to left side. The parametritis obviously was a blood stream infection from bacillus coli.

Infections by contiguity are mostly due to appendicitis. This disease often produces the most extensive perimetritis with tubal and ovarian complications. We have all had cases of this type. However, it is often difficult to ascertain if the perityphlitic inflammation is primary or secondary. In the case of a patient of mine this difficulty was removed. She had appendicitis, then called inflammation of the bowels by the old family physician, at the age of 2. After marriage 22 years later, the old focus flared up, necessitating operation.

Findings were equal to those of the most intense *ascending* infection. The traumatism, however, caused little peritoneal reaction, in spite of complete organization of adhesions, demonstrating the comparative safety of operations after *descending* infection.

Chomè[1] describes a peculiar variety of ovarian infection, which I would classify as descending; a non-puerperal abscess of the ovary. It is an infection of the ruptured follicle of the ovary, forming an abscess of corpus luteum as indicated by the lining of the abscess cavity which consists of luteinic membrane—and by the intact state of the remainder of the ovary. It is especially in connection with adhesions of ovary to intestines that this abscess occurs.

The usual origin of tuberculosis of the pelvic peritoneum, tubes, and ovaries is by descending infection. Primary tuberculosis of the cervix is very rare. Moore[2] describes a case of primary tuberculosis of cervix. He attributes the origin to infection by the blood-stream, to descending extension from the tubes and ovaries, or to coitus with, *horribile dictu*, tubercular sputum as a lubricant. Carstens[3] warns against removal of tubercular tubes and ovaries in young women when operating for tubercular peritonitis, as tuberculosis of the peritoneum is a descending infection, i.e., of systemic origin, and, except in the rare instance stated, does not come from the outside through tubes.

[1] Arch. mens. d' obst. et de gynéc., Par., 1919.
[2] Surg., Gynec. & Obst., 1919, xxix, 1.
[3] J. Am. M. Ass., 1919.

SUMMARY

I wish to emphasize the following points:

1. The classification of pelvic infections into ascending and descending is not merely academic but of practical value for better analysis of the cases, especially with regard to prognosis.

2. Operations for *descending* pelvic infections are rarely connected with grave danger, once the infection has reached the quiescent or elective period.

3. One should seek to make a differential diagnosis in the *ascending* type, i.e., between puerperal and gonorrhœal infections, before operation, as the prognosis depends on proper diagnosis.

4. Judicious conservatism is productive of best results.

INTUSSUSCEPTION RESULTING FROM BENIGN TUMOR OF THE INTESTINE

Report of Three Cases[1]

By A. MURAT WILLIS, M.D., F.A.C.S., Richmond, Virginia

From the standpoint of the surgeon, it is usually held that benign tumors of the small intestine are comparatively unimportant. The basis for this view exists in the infrequency of the occurrence of such neoplasms and also in their non-malignant nature. How seldom benign tumors are encountered anywhere in the gastro-intestinal tract seems illustrated by the paper of King (11), appearing in 1917, in which it is stated that a careful search of the literature enabled the author to find the reports of only 118 cases of benign intestinal tumors where the diagnosis had been confirmed histologically. Among the reports collected by King were those of 17 adenomata, and, of this number, only 5 were located in the small intestine. It has been pointed out by Rhodenburg (15) that King was too conservative in the selection of cases for his summary, omitting reported instances of lipomata, myomata, and fibromata which had been confirmed histologically. The same criticism seems to be valid in regard to his selection of adenomata, as will be shown later. But, although wanting in strict accuracy, King's paper serves to show that the occurrence of such tumors is uncommon in the experience of surgeons.

Kasemeyer (9) has emphasized that these so-called benign tumors not infrequently may give rise to serious or even fatal disturbances. A profound degree of anæmia may result from the constant hæmorrhage following trauma to the new-growth, but of particular interest in this connection is the possibility of intussusception resulting from their presence.

During the past 10 years in my private work, it has been my fortune to encounter one case of fibroma and two cases of adenoma of the small intestine. These cases are interesting, not only because of their comparative rarity, but also because in all 3 patients a condition requiring prompt surgical intervention existed; namely, an intussusception. The report of cases is as follows:

Case 1. M. W., female, age 8., admitted to Johnston-Willis Sanatorium on September 9, 1919. The family history is negative. The patient has never been healthy, but has been weak and undernourished. For the past 2 years she has suffered with severe abdominal pain, regurgitation of food, and at times constipation. For 72 hours before admission to the hospital she suffered with an attack of severe abdominal pain accompanied by nausea, vomiting, and constipation. On admission, she appeared sick and toxic, and had persistent vomiting. Physical examination showed a weak, emaciated child, apparently undernourished. She had tenderness over the abdomen, and a mass could be palpated in abdomen, approximately in the midline, just below the umbilicus, and about size of a lemon. A diagnosis of intussusception was made and operation advised.

The abdomen was opened through a right rectus incision, and an intusssusception of the ileum,

[1] Read before Southern Surgical Association, New Orleans, December 18, 1919.

which was impossible to reduce, was delivered. We resected 18 inches of the small bowel up to within 6 inches of the ileocæcal valve, removed the gangrenous bowel *en masse*, and did an end-to-end anastomosis. On opening the specimen a tumor was found at the apex of the intussusceptum. The patient died 14 hours later. No autopsy.

Pathological report. The tumor was globular in shape and measured about 2 centimeters in diameter. It was hard and smooth, and imbedded in the serous coat. Microscopic examination showed the tumor to be made up of a dense fibrous tissue. Diagnosis: fibroma.

Case 2. W. B., male, age 16, admitted to Johnston-Willis Sanatorium, June 29, 1910. The family history was negative. The patient has always been healthy, except that for several years he has been subject to attacks of abdominal pain. A year before coming under our care, a diagnosis of appendicitis was made and the appendix removed; without, however, affording relief from the abdominal pain. A week before admission, the patient suffered from an attack of abdominal pain of unusual severity, accompanied by nausea and vomiting. On admission, he complained only of general abdominal tenderness. Physical examination revealed a strong, well-nourished boy, apparently in perfect physical condition; a three-inch scar over McBurney's point; slight abdominal distention and general tenderness on palpation.

It was deemed advisable to employ expectant treatment and keep the patient under observation, in the hope that another attack of pain might occur and a clue be obtained as to the cause. Ten days after admission, he was seized with severe abdominal cramps. Examination revealed a mass lying across the abdomen. A diagnosis of obstruction was made, and operation advised.

The abdomen was opened through a right rectus incision. As soon as the peritoneum was incised, a very much thickened and enlarged small bowel came into view. The mass which had been palpated previous to operation was delivered outside the wound and found to consist of an invagination of the ileum, at least 3 feet in length. The intussusception was easily reduced, revealing the presence of a tumor about the size of a pigeon's egg and occupying the apex of the intussusceptum. Below the tumor, the lumen of the intestine was greatly enlarged, the walls being much thickened and hypertrophied, giving an appearance such as is often seen in the intestine above a partial chronic obstruction. Since, however, in this case the hypertrophied gut lay below the tumor, its occurrence could only be explained by the repeated formation and reduction of an intussusception. The wall of the intestine was incised at the site of the tumor and an elliptical portion of the wall, bearing the attachment of the tumor, was excised. Microscopic diagnosis: adenoma.

Since we now had a widely dilated portion of intestine lying below a portion of normal size, the problem was presented: how to prevent the recurrence of the invagination. This was solved by reducing the caliber of the dilated gut through the introduction of several rows of sutures which caused a plication of the wall.

The patient reports that he was completely relieved from the abdominal symptoms and that he is in excellent health 9 years subsequent to the operation.

Case 3. A. K., female, aged 7, admitted to Johnston-Willis Sanatorium on April 6, 1919. The family history is negative. One year prior to admission, the patient had an attack of abdominal pain of great severity, but recovered without being seen by any physician. Three weeks ago, a similar attack occurred, lasting several hours. Again, no physician was called. Three hours before admission, while playing in park, the patient was seized with agonizing abdominal pain, accompanied by nausea and vomiting. The pain was so severe that the child was completely prostrated. Physical examination showed a mass, several inches in diameter and about a foot in length, extended diagonally across the abdomen, just above the umbilicus. A diagnosis of intussusception was made.

Two hours after admission, the condition being unaltered, operation was advised. Through a midline incision, the mass was delivered and found to consist of an ileal intussusception, about 2 feet in length. The invagination was reduced with great difficulty and, as in the preceding cases, a small, pedunculated tumor was found at its apex. The serosa over the attachment of the tumor presented a puckered appearance, resembling that sometimes seen in the skin over early carcinoma of the breast. For this reason, it was deemed wise to resect about 6 inches of the small intestine, followed by end-to-end anastomosis. The child was reported fully recovered 8 months after operation.

Pathological report. The tumor measured 2 centimeters in length, 1 centimeter in thickness, and 1 centimeter in depth. It was soft, smooth, and pinkish-gray in color, and it was attached to a small portion of the bowel wall by a pedicle which measured one-half centimeter in length and one-half centimeter in thickness. On section it appeared to be lobulated and the lobules varied in size from a pinpoint to a pin-head. Microscopic section (transverse) showed the tumor to have a gland-like structure, not unlike that seen in a normal mucosa. The acini were lined by a columnar epithelium and goblet cells. Some of the acini were cystic and contained mucus. There was a connective-tissue stroma between the gland-like collections of epithelium. Near the pedicle and in the region of its attachment to the bowel wall the acini suggested a malignant degeneration, but there was no apparent invasion of the bowel wall. Diagnosis: adenoma.

All of my cases were in children from 7 to 16 years of age. Symptoms of recurring attacks of abdominal pain, extending over a

period of 1 to 5 years, occurred in all. The tumor was in the ileum in every instance. It was necessary to resect the bowel in two cases of acute intussusception. In one case, a chronic reducible type, plication of the bowel was all that was necessary. Two recovered, one died. Microscopic examination showed one to be a fibroma and two to be adenomata.

Summaries of the reported cases of fibromata of the intestine have been made by King (11) and also by James and Sappington (8), the latter authors being able in 1917 to collect from the literature the reports of 25 cases of intestinal fibroma. Rhodenburg (15), in April, 1919, reported two more cases and another has been reported by Henrichsen. I have been particularly interested, however, in the adenomata and shall confine myself chiefly to a discussion of this type of tumor.

As has already been mentioned, King, in 1917, was able to find recorded in the literature the reports of only five adenomata of the small intestine, and in only two of these cases was the tumor accompanied by intussusception. On the other hand, Kasemeyer, 5 years before the appearance of King's paper, collected the reports of 10 cases of adenoma of the small intestine complicated by intestinal invagination.

In addition, I have been able to find the following cases of adenoma associated with intussusception reported, which, though the diagnosis was confirmed by miscroscopic examination, were omitted from Kasemeyer's and from King's summaries:

Scudder (16): Young male adult. Adenoma of ileum accompanied by intussusception and volvulus. Operation. Recovery.

Watts (18): Male, age 24. Multiple adenomata; recurring intussusception. Operation. Recovery.

Brataud (1): Female, age 16. Multiple adenomata; recurring intussusception. Operation. Recovery.

One paper, containing report of two cases by Hartmann (6).

Since the appearance of King's paper, reports of the following cases of adenoma of the small intestine associated with intussusception have been published:

Keilty (10): Male, age 23. Adenoma of jejunum with intussusception. Succumbed.

Ludlow (13): Young male adult. Adenoma of jejunum with intussusception. Operation. Recovery.

So far as I have been able to ascertain, only 17 authenticated cases of adenoma of the small intestine associated with intussusception have been reported. The addition of my 2 cases brings the total number to 19.

The manner in which the intussusception is produced has never been satisfactorily explained. The view which seems most natural to accept is that the body of the tumor, lying within the lumen of the intestine offers an object which the wave-like contractions of the circular muscle can grasp and force onward, exactly as they do with a bolus of food. As a result of this forcing onward of the tumor, traction is exerted on its point of attachment, tending to pull inward and downward this part of the intestinal wall, thus starting an intussusception, which is increased by the subsequent waves of peristalsis. This method of formation seems to have been demonstrated in the cases reported by Fuchsig (4), Smoler (17), Brataud (1), and Watts (18), where milking the tumor downward caused a depression in the wall of the gut at the point of the tumor's attachment and, later, a beginning invagination.

Against this theory, two objections have been raised: First, in a certain number of cases where tumors have given rise to intussusception, the tumor has not occupied the apex of the invagination. This, it seems, to me, does not disprove the theory. If we accept the view that the intussusception is sometimes formed and may then undergo spontaneous reduction, it is at least possible that those cases where moderately large tumors are not at the apex of the intussusception represent instances where the process of reduction is taking place, the waves of reversed peristalsis having seized the tumor and carried it backward.

On the other hand, those cases where many small tumors are accompanied by intussusception cannot be explained by this "mechanical" theory. Here we are forced to accept the explanation of some abnormal "stimulus" to the intestinal wall. Attempts have been made to explain the mode of action of this "stimulus," but one is forced to conclude that none of the explanations is satisfactory. Nothnagel and Morris (9) believe that

a spastic contraction of a portion of the gut occurs and this contracted part forms a fixed point, the intestine immediately below being drawn up over it, forming the intussuscipiens, while the contracted part is the intussusceptum. Peyer (9) and Leichtenstern (11) hold, on the contrary, that the essential condition leading to intussusception is a localized paralysis of the intestine; the paralyzed part, according to Peyer, forming the intussuscipiens; to Leichtenstern, the intussusceptum.

The records of certain surgical clinics also seem to indicate that adenoma of the small intestine necessitating surgical intervention is rarely encountered. Thus, King states that no such case occurred among 44,654 abdominal operations at the Mayo Clinic, nor did any appear in the records of the abdominal operations at the Charity Hospital of New Orleans "for many years back," although about 10,000 operations were performed annually at this institution.

In approximately 25,000 operations at the Boston City Hospital, adenoma of the small intestine was encountered only once, and was not associated with intussusception.

In spite of this evidence, I am inclined to suspect that adenomata as well as other benign tumors of the small intestine are not so extremely uncommon. When one reviews the histories of practically all of the reported cases, two striking features are to be observed: first, the patients were seriously ill when they came under the care of the surgeon; and, second, there is good reason to believe that similar, but less severe disturbances had taken place in the past but spontaneous relief had occurred. This latter point is well illustrated by the 3 cases I have reported. In all of them the history strongly suggested the previous occurrence of intussusception, and the appearance of the intestine at operation in Case 2 proved that such an occurrence had taken place.

It has been demonstrated that pedunculated tumors may be torn from their attachment (9), and I believe that this may not be very uncommon. It seems not unlikely that the constant pressure and tension may cause the new-growth to atrophy in some cases; while in still others, they may never attain sufficient size to cause any disturbance. Finally, we must remember the possibility of benign tumors undergoing malignant degeneration and admit that a certain proportion of intestinal carcinomata and sarcomata may have originally existed as adenomata or myomata.

It does not seem unreasonable, therefore, to assume that the patients who are critically ill, whose condition is such as to demand immediate surgical intervention, constitute only a small proportion of the cases of benign intestinal tumor and the possibility arises that a certain number of individuals who suffer from recurring attacks of abdominal pain may owe these symptoms to the presence of a benign tumor of the intestine. This view is strongly supported by the autopsy records from the Boston City Hospital which were recently communicated to me through the courtesy of F. B. Mallory. In a total of 4,165 autopsies, adenomata of the small intestine were encountered four times, giving an incidence of almost one case of every thousand that came to autopsy. Benign tumors of all kinds were encountered in eleven instances.

In addition, through the kindness of Drs. Wright and Richardson of the Department of Pathology of the Massachusetts General Hospital, Mr. A. M. Bagusin investigated the records of 3,327 autopsies performed at that institution. A total of eight benign tumors of the small intestine was encountered in this series, but only one adenoma.

The fact that my own cases were operated on at a time when obstruction due to intussusception had produced a serious abdominal emergency, indicates that tumors of the small intestine may be an etiological factor in the intussusception of young children. There are several reasons for overlooking a tumor of the small intestine when operation is done for the resulting intussusception.

If the invaginated gut is reducible, and resection not advisable, a small tumor projecting into the lumen may easily escape detection, owing to the œdema and infiltration of the intestinal wall.

It is also reasonable to assume that a pedunculated tumor occupying the tip of the

invaginated gut, and therefore the zone of great ischæmia, would be destroyed by gangrene in many cases, while the gut with its nutrition less impaired might regain its normal vitality after reduction of the intussusception and the application of moist heat.

Operations for intussusception in young children are often grave emergencies and the surgeon is chiefly concerned in making a decision between simple reduction and excision of the invaginated gut. It is reasonable to assume that many specimens of intestine removed at operation for intussusception, if carefully studied, will show the remains of a tumor, spontaneously destroyed by interference with its vascular supply.

This hypothesis is not submitted as an explanation of all cases of intussusception in children. More and better study is necessary to determine the relationship between tumor and invagination.

CONCLUSIONS

In conclusion, the following points seem to deserve especial emphasis:

1. The possibility, or indeed, the probability exists that benign tumors of the small intestine are of more frequent occurrence than the number of cases reported from surgical clinics would lead one to suspect.

2. There is no reason to believe that the material from the Boston institutions is unique and that Bostonians suffer from benign intestinal tumor more than persons in other localities. Accepting this, we face the striking fact that approximately one person in every 1,500 coming to autopsy shows the presence of adenoma of the small intestine. Even more striking is the fact that in the 7,492 autopsies, benign tumors of the small intestine were encountered 19 times, so that we have an incidence of nearly one to every 400 autopsies.

3. In considering the few cases of adenoma that have been reported by surgeons, it must be remembered that many of the so-called "polyps" are adenomatous in structure, but cannot be included because of the failure to make a histological examination of the tumor.

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DEPARTMENT OF TECHNIQUE

SOME PLASTIC OPERATIONS ON THE RECTUM

By HARVEY B. STONE, M.D., F.A.C.S., Baltimore

THIS article is written to present, as briefly as possible, four operative procedures for the correction of rectal conditions of various types. Descriptions of some of them have been published before but are again described because they seem worthy of further notice.

1. In a certain number of cases following Whitehead operations for hæmorrhoids, the mucocutaneous margin instead of being within the anal canal is externalized; that is, a ring of everted mucosa extends around the anus. This probably results from the neglect of a precaution emphasized by Whitehead himself; the careful preservation of all skin so that the mucosa will not be pulled down and outside the sphincter in order to make the repair suture at the end of the operation. When such a condition exists there is a constant moisture about the anus, with erosion of the everted mucosa, pain, and bleeding. To correct it the following plan has been successful.

With the patient in the perineal position, two V-shaped incisions in the skin on each side of the anus are made. The angle of the V is placed about over each ischial tuberosity and one arm runs forward toward the center point of the perineum and the other back toward the tip of coccyx. These incisions, however, are not carried across the midline either anterior or posterior to the anus, but end about 1 inch lateral to the midline on each side. The flap of skin enclosed between the V on each side is loosened up but not extensively undermined, and is pushed medianward toward the anal margin. The outer edges of the V incisions are then sutured to each other, converting the V into a Y and crowding the enclosed skin area toward the anus and holding it there.

The faulty mucocutaneous margin is then divided by a circular incision, the mucosa dissected upward into the anal canal until a cuff of it is freed all around, and this cuff then amputated. The mobilized skin edge is then sutured to this shortened mucosa, pulling it well up into the anal canal. In short, this part of the operation is simply a repetition of the original Whitehead, with a mobilized and sufficient skin margin to repair the fault of the first operaton (Fig. 1).

2. In certain special types of stricture of the rectum, an application of the principle of the Heinecke-Mickulicz pyloroplasty is helpful. These strictures are of the diaphragm type; that is, firm, with small lumen, but narrow, and annular in their involvement of the long axis of the bowel. The stricture is incised in the posterior midline down to its base, and the superior and inferior edges of the incision are sutured to each other, so that the line of repair runs transverse to the long axis of the bowel. After having employed this measure several times, I found that it had already been described by Arthur Dean Bevan, in the *Surgical Clinics of Chicago*, in 1917.

3. In tubular strictures of the rectum, occurring in the lower 4 inches of the bowel in multiparous women, the utilization of part of the voluminous vaginal mucosa as a transplant into the rectum has been tried. This has been done only when long-continued dilatations have failed to give relief, and where the Wassermann test has been for a long time negative. The posterior vaginal wall is incised longitudinally in the midline, exposing the strictured rectum from in front. Some of the scar tissue about the rectum is dissected away, and then it is incised longitudinally in the anterior midline. The edges of the vaginal incision are sutured to the corresponding edges of the rectal mucosa, thus forming a rectovaginal fistula, then on each side of this fistula a flap of vaginal mucosa about an inch wide is outlined, and its outer edge dissected up, leaving the inner portion about the rectovesical fistula still attached. The freed outer edges of these two flaps are turned over toward each other, and sutured together in the midline, thus causing the flaps to fold over and face downward toward the rectum. The remaining vaginal mucosa is then brought together over these reversed flaps, burying them in the rectum, and the posterior vaginal wall is repaired. This procedure implants two, inch wide strips of mucosa in the rec-

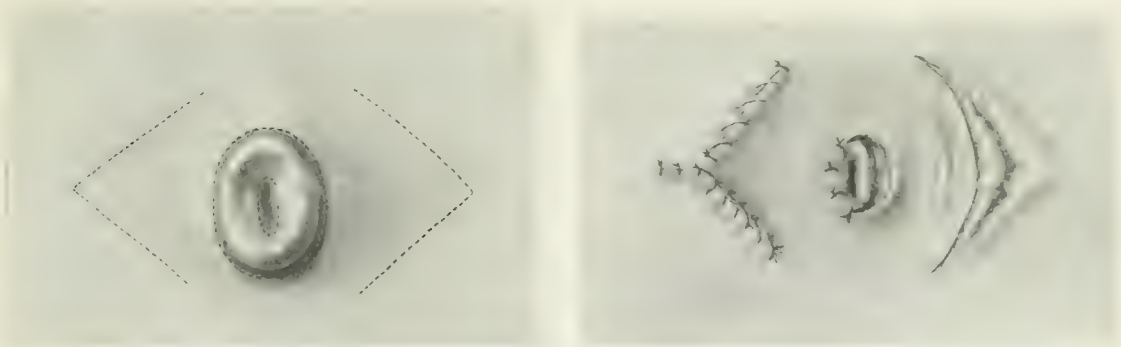

Fig. 1. Incisions and sutures for repair of faulty Whitehead operations with everted mucous membrane.

Fig. 2. A sagittal section showing type of stricture in which vaginal mucosa may be utilized.

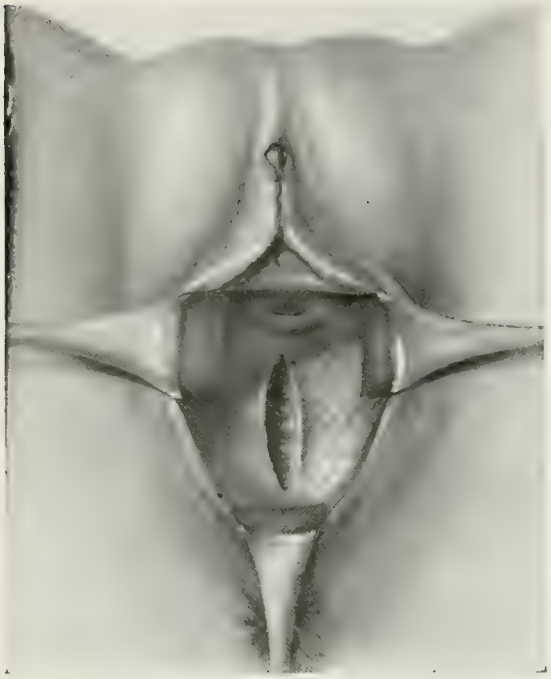

Fig. 3. Incision in midline of posterior vaginal wall.

Fig. 4. Incision carried through anterior wall of rectum, dividing stricture.

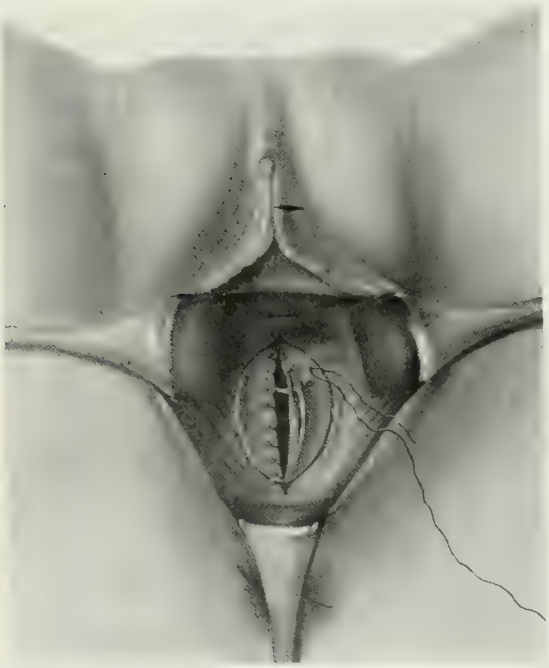

Fig. 5. Suture of rectal and vaginal margins and outline of vaginal flap.

Fig. 6. Freeing of edges of vaginal flap.

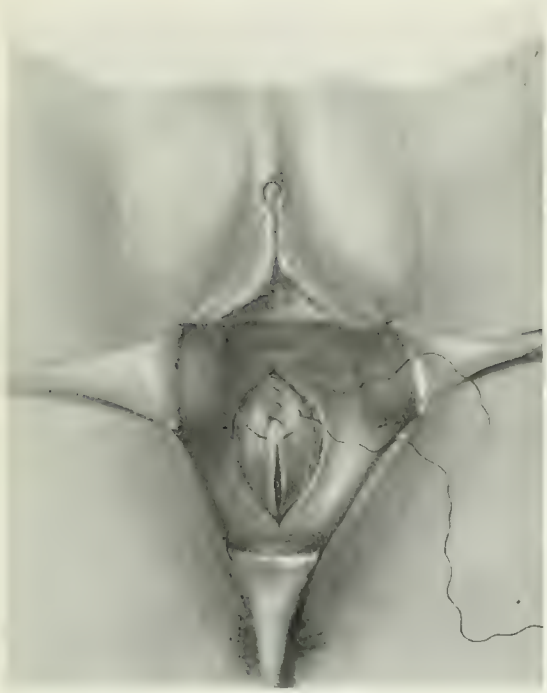

Fig. 7. Outer edges of vaginal flap sutured together across the midline.

Fig. 8. Repair of posterior vaginal wall.

tum and widens the stricture very materially (Figs. 2, 3, 4, 5, 6, 7, and 8).

4. With the collaboration of Hugh H. Young, an operation has been devised for the correction of recto-urethral fistula in the male. Case reports with details of a number of such operations have been published elsewhere. In this paper only an outline of the method will be given. The first step is the establishment of urinary drainage by a suprapubic cystostomy. Then a midline incision in the perineum, begun at the midpoint of the perineum, is carried backward to the anterior anal margin, and then about the anus at the mucocutaneous junction. The bowel is then dissected upward as in a Whitehead operation, and the sphincter divided in the midline anteriorly. The incision permits the exposure of the deep urethra through the perineum and the mobilization of the rectum, which is dissected loose all around, to a point well above the entrance into the bowel of the fistula. This dissection, of course, divides the fistula. The urethral orifice of the fistula is now closed by sutures placed over a sound. The bowel is brought down until the rectal orifice of the fistula is drawn outside the skin level and fixed in this position by stay sutures. The perineum is reconstructed by drawing the muscles together and the sphincter is repaired. The distal extremity of bowel, bearing the fistula, is amputated, and the stump of proximal bowel sutured to the anal skin as in Whitehead repair. The perineal incision is also closed. The advantages of this operation are direct closure of the urethral orifice, the complete removal of the fistulous area of rectum, the interposition of perineal structures between rectum and urethra, and the temporary diversion of the urine. It has proved very successful in practice.

A NEW AND EFFICIENT METHOD FOR THE USE OF WIRE IN SURGERY OF THE BONES

By JAMES M. NEFF, M.D., F.A.C.S., and JOHN G. O'MALLEY, M.D., Chicago

THE use of wire in surgery of the bones has a limited field but that it has a very definite place, in which no other method is practicable, must be admitted by all surgeons. During our service with the British army in France in 1915, we evolved a method which we believe to be new and original with us and, furthermore, cannot be improved upon. As regards the indications for the use of wire, they are practically unlimited but those which we have encountered may be summarized as follows:

1. The holding of any small fragment in apposition with a larger fragment where it cannot be done by the closed method; for instance, (a) a short lower end of the radius displaced forward and upward where the flexors act strongly and overcome the extensors; (b) the holding in place of certain bone transplants so that they will remain in strong and accurate apposition—something that cannot be done in the majority of cases with kangaroo tendon, or chromicized catgut; (c) the holding in position of bone fragments in comminuted fractures such as of the lower end of the humerus, where it is essential that these fragments be held in place and remain so until union takes place; (d) fractures of the lower jaw where the fragments will not remain in place and where it is inadvisable for certain reasons to use an interdental splint; (e) in oblique fractures of the clavicle where a plate cannot be easily and safely applied; (f) in fractures of the patella and the olecranon process of the ulna.

These indications have come to our attention, but the method may be elaborated to cover any number of conditions which may arise in the practice of bone surgery. We do not advocate it in fractures of the long bones, where very strong support is needed to hold the fragments in apposition, as in the shaft of the humerus, femur, tibia, or both bones of the forearm. In these we are firm advocates of the use of the Lane plate applied after Lane's "no-hand contact" method. We make this assertion after an enormous experience in both military surgery in France and civil surgery here. In the above indications, we refer only to simple fractures, but the wiring process, which will be described later may be used in many compound fractures where slight support is indicated.

Now, as regards the technique of our method which was evolved by us in France in 1915: Let us take as a typical example for illustration a fracture of the lower end of the radius, produced by falling on the back of the hand and in which the plane of fracture is from behind forward and upward with a displacement of the small lower fragment in the same direction (see Case B). In such cases it is impossible to hold the lower fragment in position by the closed method because of the strong flexor tendon pull. The technique of the operation is extremely simple. We follow Lane's method throughout, as we do in all bone and joint operations; that is, the fingers do not enter the wound and all instruments and sutures introduced into the open wound are not touched by even the gloved hands of the nurse or surgeons.

An incision is made over the outer side of the lower end of the radius parallel to the long axis of the shaft. Wound towels are sutured to the margins of the skin, and the tendons of the extensor brevis pollicis, extensor carpi radialis longior and brevior are exposed and retracted. This brings us down to the bone, both proximal and distal to the fracture (Fig. 1). A periosteotome is now used to clear the surfaces of the bone at the site of fracture and all structures are retracted. With a medium sized lion jawed forceps the lower fragment is brought into absolutely accurate approximation with the shaft and held there by another lion jawed forceps, which firmly grasps both fragments. An ordinary bone drill is now used to drill through both fragments at their point of greatest density (see Fig. 2). A silver or copper wire of proper gauge, which has been previously prepared (to be described later), is passed through the drill holes of both bones, brought out to the surface and caught by forceps at each end. The wire is now drawn taut in opposite directions so as to hold the fragments firmly in accurate apposition. This is done by having an assistant make traction on one end of the wire while the operator does likewise with the other, as will be seen by illustration (Fig. 2). This procedure brings the terminal portions of the wire in lateral and parallel contact with each other. Over the adjacent parallel wires a small quantity of liquefied zinc chloride is applied with any kind

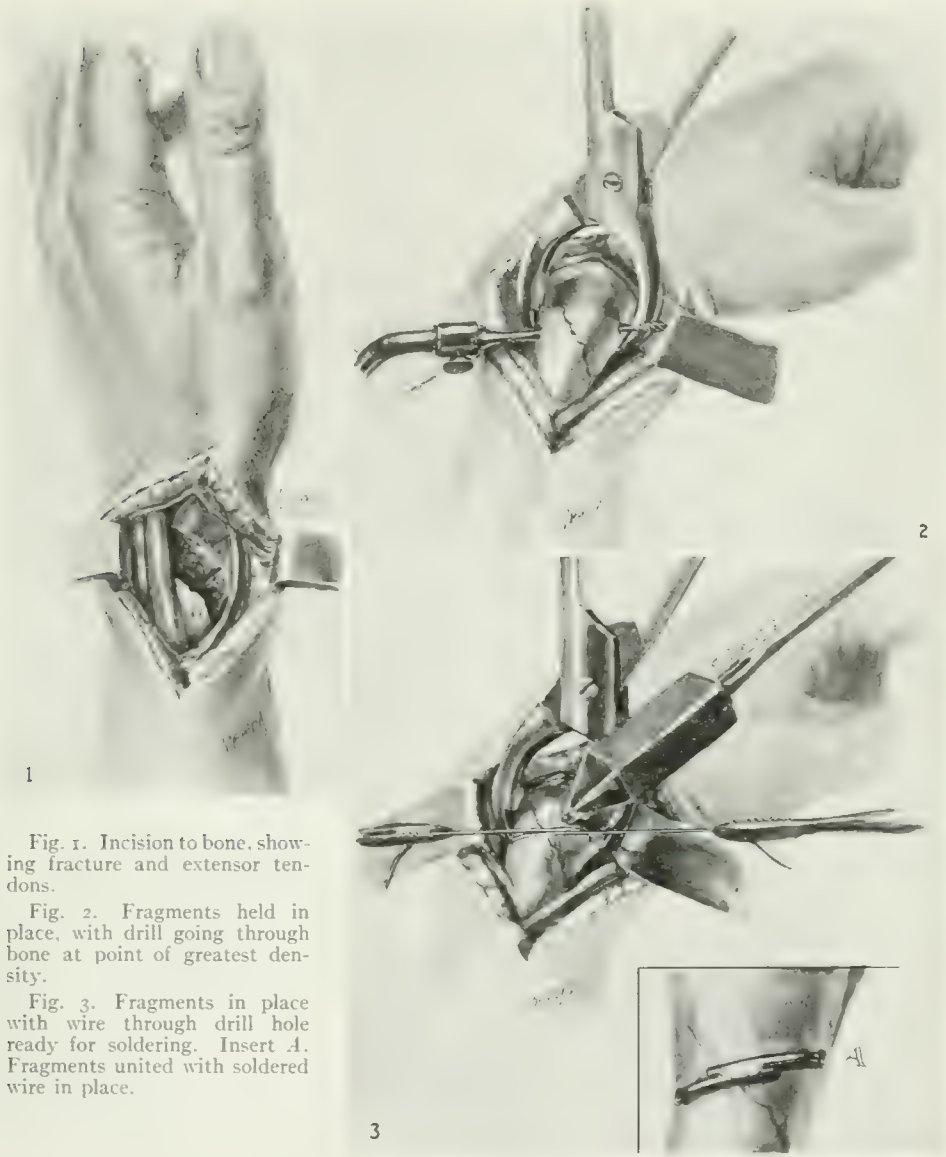

Fig. 1. Incision to bone, showing fracture and extensor tendons.

Fig. 2. Fragments held in place, with drill going through bone at point of greatest density.

Fig. 3. Fragments in place with wire through drill hole ready for soldering. Insert *A*. Fragments united with soldered wire in place.

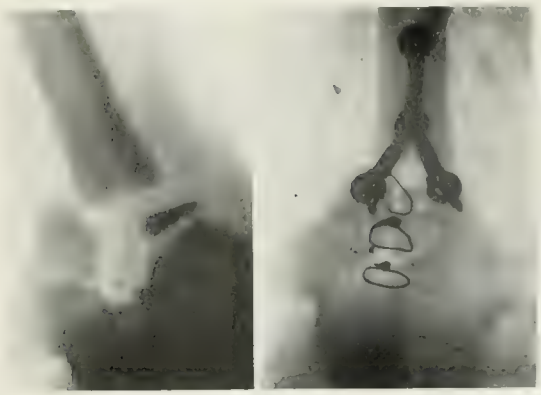

Fig. 4. Case A. Before operation. Internal condyle shows, but external condyle is not present in roentgenograph.

Fig. 5. Case A. After operation with condyles united by soldered silver loops. Condyles united to shaft by Y Lane plate.

of metal applicator, such as an ordinary hæmostat. An ordinary tinner's soldering iron properly prepared (to be described later) is used by the operator for the purpose of picking up a small drop of electrician's solder and, while proper tension is exerted by operator and assistant in pulling the ends in opposite directions, the adjacent parallel portions of the wire are soldered together by merely running the tip of the iron carrying the molten solder over them (Fig. 3).

This procedure requires but a moment and, when finished, we have a complete circular band of metal firmly uniting the fragments in perfect apposition, with no possibility of ever loosening or breaking. With an ordinary bone-cutting forceps the unused part of the wire on each side of the soldered portion is now cut flush with the band uniting the fragments (Fig. 3, insert *a*).

As formerly used the wire was twisted upon itself, cut off, and the ends turned down. During this extremely unmechanical procedure the wire was very often broken during the twisting or turning process. There was always an awkward end to deal with and there was no assurance of the wire maintaining its original tension over any period of time.

With the new process described above, the wire band remains forever at the original tension at which it was soldered, there is no possibility of breakage during the soldering process, and there are no awkward ends to deal with. In other words, we have a continuous metallic band which maintains its original tension indefinitely, a smooth surface at the site of union, no irritation from the twisted ends, no possibility of breakage at any time and the assurance of complete asepsis produced by the heat of the "iron."

We consider the method ideal in every respect and by its elaboration should open a new field in bone surgery.

PREPARATION OF THE SOLDERING IRON

An ordinary tinner's soldering iron of medium size is used. With a coarse file the four surfaces of the iron are filed down to a point so that the copper presents a bright glistening surface. It is now heated in the blue flame of a gas stove, or Bunsen burner to a temperature where it will melt the solder upon contact. The tip and one-half or three-quarters of an inch of the four surfaces are now dipped into zinc chloride crystals and then brought into contact with soft electrician's solder. This will tin the soldering iron. In other words, the solder will adhere as a thin film to the sides and tip of the iron. It is now ready for use in the operation.

PREPARATION OF THE WIRE

As stated before, either silver or copper wire may be used. The gauge of the wire will depend upon the size of the bone and the tension that must be used to hold the fragments in apposition. The wire is drawn straight by traction on each end and passed through the blue flame of a gas stove or Bunsen burner in order to burn off any grease that may be present. While it is kept on tension it is rubbed over with liquefied zinc chloride on an applicator. The prepared and heated soldering iron carrying a small drop of solder is now passed over the entire length of the wire and around its circumference. This will cause a thin film of solder to adhere to the wire as it did to the iron. While wire and solder are still hot they may be wiped off with clean dry gauze to carry away any excess of solder and leave a smooth surface. The wire is now ready for operation but should be boiled with the instruments before being used.

The iron is used during the operation by wrapping the handle in a sterile towel as in the use of the Paquelin cautery.

Two cases are reported to illustrate the efficacy of the method.

Case A. Male, age 47, tripped and fell February 23, 1918, striking on the right elbow. In attempting to arise he again fell upon the same elbow. The arm and forearm were put in cast and nothing further done until the case came to our attention, March 12, 1918. At that time the elbow was greatly swollen and painful with a definite false point of motion about 2 inches above the olecranon. X-ray findings: transverse fracture of the shaft of the humerus 2 inches above the articular surface, with a

Fig. 6.

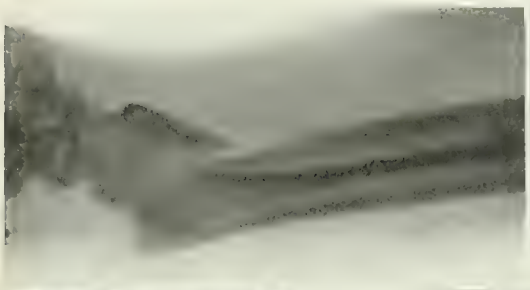

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 6. Case B. Before operation, after attempts at reduction had failed.

Fig. 7. Case B. Lateral view after operation, wire holding fragments in place.

Fig. 8. Case B. Anteroposterior view after operation.

Fig. 9. Case B. Lateral view 3 weeks after operation, showing perfect union with wire in place.

Fig. 10. Anteroposterior view 3 weeks after operation.

vertical fracture into the joint separating the condyles. The external condyle was not visible in the roentgenogram (Fig. 4).

Operation, March 13, 1918. Lane's technique followed throughout. A vertical incision was made over the posterior aspect of the arm, elbow, and forearm down to the bones. The X-ray findings were confirmed, that is, we found a transverse fracture of the shaft with a vertical fracture into the joint, splitting and separating the condyles. The internal condyle was rotated inward and was readily brought into place. The external condyle was not to be seen, but upon opening the capsule of the joint it was found to have rotated downward, presenting the articular surface upward. This was now brought into position by the side of the internal condyle. By means of three holes drilled through both condyles, silver wires were passed through, drawn taut and soldered, holding the condyles in firm apposition. The condylar portion of the lower end of the humerus was now secured to the shaft by means of a Y-shaped Lane plate, the limb of the Y being screwed to the shaft of the humerus and each lateral arm to the internal and external condyle respectively (Fig. 5). The ulnar nerve was protected throughout by being carefully drawn aside after its isolation. No drainage was used and the skin was closed by catgut suture. A plaster-of-Paris cast was applied, and the arm put up at an 80 degree angle. Union was firm and complete 7 weeks after operation when great callus formation showed in the roentgenograph. In order to secure proper function in the elbow-joint, this callus was removed and a piece of the superficial triceps aponeurosis was interposed between the articular surfaces of the humerus, ulna, and radius. At the time of last operation the plate and wires were removed.

Case B. Male, age 18; while playing football December 2, 1919, was thrown to the ground, falling backward. In attempting to save himself he placed his right arm back of him and fell with the dorsal surface of the hand striking the ground. Patient suffered great pain at the time, and the wrist began to swell immediately. He was taken to a hospital where, two days later, an attempt was made to reduce the fracture. This and two succeeding attempts under general anæsthesia were unsuccessful in holding the fragments in position. He was then brought to Chicago where roentgenogram showed a fracture of the lower end

of the radius with the lower fragment displaced forward and upward (Fig. 6). Another attempt was made to reduce the fracture and hold the fragments in apposition with the closed method. This was not successful.

Operation, December 6, 1919. Lane's technique followed throughout. An incision two and one-half inches long was made over the outer surface of the lower end of the radius, the extensor longus pollicis, extensor carpi radialis longior and brevior tendons exposed and retracted, and the fracture brought into view. The fragments were now brought into apposition by means of a lion jawed forceps and held there while, with an ordinary bone drill of small caliber, a hole was bored through both fragments at the point of greatest density. The previously prepared silver wire was then passed through, drawn taut and soldered, after the manner described in the technique. Roentgenographs were taken immediately, showing fragments held in perfect apposition (Figs. 7 and 8).

The wound was closed in the usual way, catgut being used in the skin and a posterior cast applied. The patient made an uneventful recovery and at the end of 3 weeks, the cast was removed. The skin suture had absorbed, the wound healed by primary union, and passive motion was begun. Roentgenograms taken 3 weeks after operation show the wire in position, the fragments in perfect apposition, and union perfect (Figs. 9 and 10).

A MODIFICATION OF THE USUAL METHOD OF PERFORMING PUBIOTOMY [1]

By HENRY JELLETT, M.D., F.R.C.P.I., Dublin, Ireland
Late Master, Rotunda Hospital

UP to the present time two methods of performing pubiotomy have been described and are in common use: The semi-open method of Doederlein, and the subcutaneous method of Bumm. Each of these possesses certain advantages and disadvantages. In the Doederlein method, the bladder is separated by the finger from the back of the pubic bone after first making a small incision above the bone to admit the finger. In this way injury to the bladder by the needle is avoided, but at the same time a large area is opened behind the bone in which blood may collect and infection subsequently occur. In the Bumm method, on the other hand, the needle is passed upward from below under the guidance of a finger in the vagina. There is no incision made in the skin and no separation of the bladder from the bone and consequently there is less risk of infection.

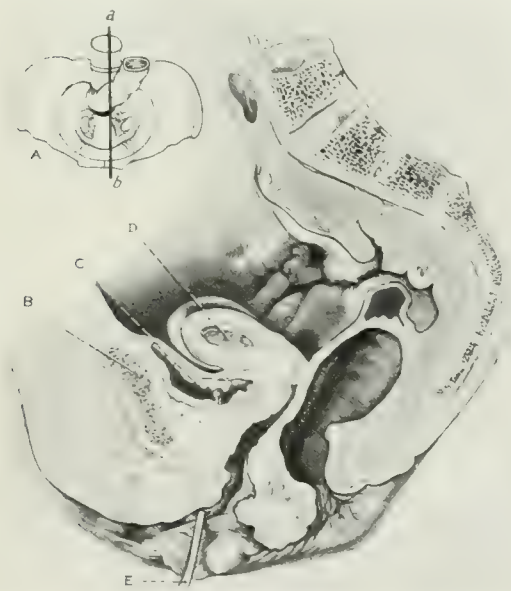

Fig. 1. Section through the pelvis passing through the usual site at which the pubic bone is divided (Liepmann). *A*, Line of section; *B*, cut surface of pubic bone; *C*, bladder; *D*, uterus; *E*, pointer in urethra.

Fig. 2. Diagram to show the manner in which the guiding finger in the vagina can push the bladder into the track of the needle.

[1] The following is a short addendum to an article on "The Radical Cure of Pelvic Deformity" which appeared in Surgery, Gynecology and Obstetrics, for August 1919, 117.

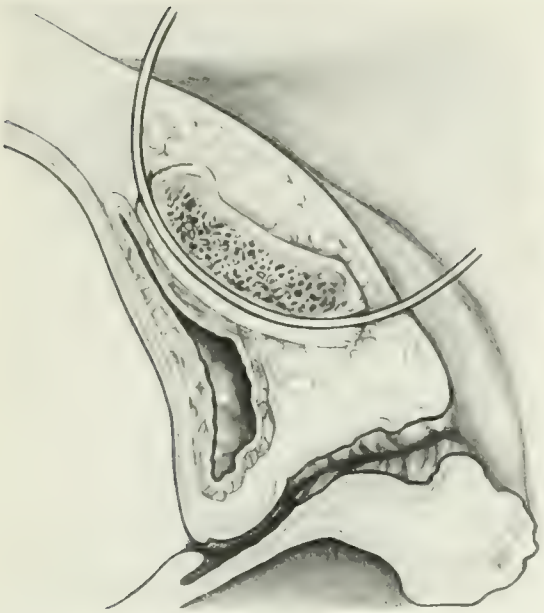

Fig. 3. The passage of the needle in the modified operation.

There is, however, a considerable risk of injuring the bladder with the needle.

The ease with which the bladder can be penetrated by a needle passed upward from below can be seen if the relations of the bladder and bone are examined in Figure 1, while the diagram in Figure 2 shows very plainly the manner in which the guiding finger in the vagina may actually push the bladder forward in the direct path of the needle. It may be said that, if the needle is kept between the periosteum and the bone, it cannot enter the bladder. This is, of course, true, but it is impossible to construct a needle with such a curve as to enable it to keep within the periosteum as the upper surface of the bone is reached, even if it has done so all along the posterior surface. The upper part of the bone is the danger point, and the danger is exaggerated by the guiding finger in the vagina.

Accordingly, I have for the past few months been in the habit of performing a slight modification of the Doederlein operation, as follows:

A small incision is made in the skin and fat directly above the point of proposed entry of the needle. This incision is carried down to the bone, and the periosteum is cut through where it passes off the upper surface on to the posterior surface. The point of the blunt Doederlein needle is then pushed through this opening and downward

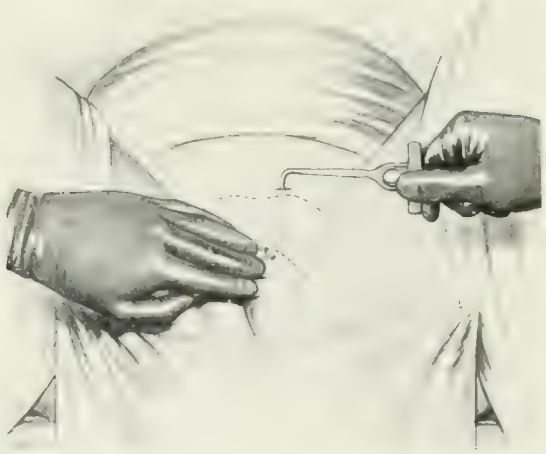

Fig. 4. Diagram to show the correct track of the needle.

beneath the periosteum (Fig. 3). The finger is only passed into the vagina, as a guide, as the needle reaches the lower edge of the bone, and even then it is not essential (Fig. 4).

The only point on which special care is necessary is in making the incision in the periosteum. If this is made directly on top of the bone, it will not be possible to detach the periosteum with the needle, as it is too firmly attached at this point. If, however, the incision is made just over the upper surface of the bone, it is usually easy to cause detachment.

It may further be said in favor of this method that, even if the needle fails to keep behind the

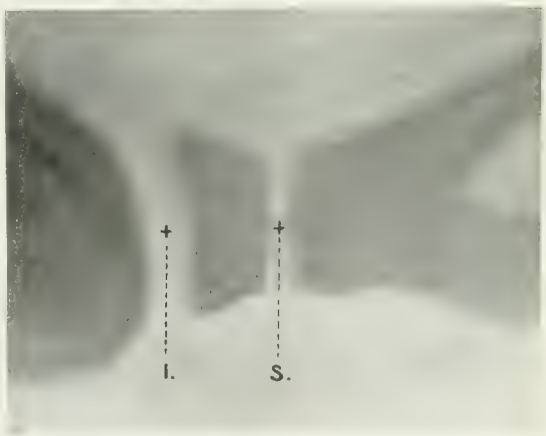

Fig. 5. Skiagram of the pubic bone after a double pubiotomy. The arrow points to the first incision with complete ossification. *I*, the second non-ossified incision; *S*, the symphysis.

periosteum, the danger of penetration of the bladder is only a fraction of what it is when the needle is passed up from below, as in the Bumm method.

I also wish to take this opportunity of reproducing a roentgenogram of the pubic bone of Mrs. G. (Cases No. 17 and 23) in my previous article (Fig. 5). This woman had a pubiotomy done by me on the left side (to which the arrow points) in 1913. She was kept very quiet after the operation with the result that bony union followed and that she was unable to deliver herself at her next confinement in 1916. In consequence pubiotomy was performed by Dr. Purefoy. This time bony union did not occur, with the result that at her next confinement in 1919 she was delivered with the forceps of a living 8½ pound child the forceps being applied on account of uterine inertia and not on account of any mechanical difficulty.

A WARNING AGAINST PROMISCUOUS UTERINE CURETTAGE[1]

By J. WESLEY BOVÉE, M.D., F.A.C.S., Washington

OF all gynecological operations performed probably the most frequent is curettage of the body of the uterus.

The invention of the uterine sound by James Y. Simpson caused exploration of the uterus with it to be a very popular procedure. One can be thoroughly convinced of that by merely consulting the *Index Catalogue of the Library of the Surgeon General's Office*. There will be found an overwhelming number of titles on the subject, and one reading even a small number of the papers there listed under the proper heading can not but be impressed with the pervading enthusiasm.

Jennison's sound, brought forward some years later, also became a favorite instrument. Its use was largely in the reposition of the retroverted uterus. I plead guilty to "triumphantly" using this instrument in 1896 and 1897. The pain thus induced when adnexal adhesions unknowingly existed is well remembered. Possibly damaging infection may have been produced by my nefarious efforts.

The uterine curette, introduced to an embryonic state of development of gynecology, as it was, rapidly attained a high degree of popularity that has continued with but slight lessening of late. That the most slovenly and ignorant physician resorts unhesitatingly to the curette for various diseases of the uterus, real or otherwise, and even of the appendages is a notorious fact. It is equally true that curettage in the office of a physician with a very lax degree of surgical cleanliness is commonly done.

That curettage has a field in gynecological procedure is not to be doubted, but the ring of limitation around it is constantly narrowing. The narrowing is not comprehended by the majority of our profession, and to those its practice is far too simple to appear dangerous, and besides it tends to easy progress toward being known as surgeons.

INDICATIONS

The principal reasons for curetting the body of the uterus are to secure material for diagnostic purposes, to remove mucous polypi in the treatment of exfoliative endometritis, calcareous areas formed by calcified submucous fibroids, and some rare cases of senile endometritis, especially following senile pyometra of chronic endocervicitis, of certain rare forms of chronic endometritis, of certain equally rare cases of hypertrophy of the endometrium, of sterility—and to remove the products of conception that can not otherwise be extracted. The principal use of curettage is to secure endometrial tissue for microscopical study.

If we contrast this scope of the indications for curettage, as legitimized by progress in scientific medicine, we will at once note its conflict with the daily routine application of this surgical procedure. It is with a sense of great loyalty to my profession that I recall with deep humiliation the many former indications for curettage which have been discredited.

Among these were the routine curettage, incident to pelvic plastic surgery. If repair of injury to cervix or vaginal wall or perineum was to be made, curettage was added and its technique included gauze drainage or irrigation, one or both. A snap diagnosis of chronic endometritis was usually the term that was added to the

[1] Read before the Southern Surgical Association, New Orleans, December 16-18, 1919.

TABLE SHOWING INCIDENCE OF BACTERIA IN CULTURES FROM GROUND ENDOMETRIUM OBTAINED AFTER HYSTERECTOMY

Type of cases	Number of cases	No growth	Total number	Gonococcus	Streptococcus	Diplococcus	Diphtheroid	Bacillus coli	Mixed	Remarks
Nullipara without history or gross evidence of infection	26	23	3		1				2	The two cases with mixed growth were curetted a few days previously.
Nullipara with history or gross evidence of infection	13	12	1	1						One case revealed chronic tuberculosis. No bacteria were obtainable from one case with distinct inflammatory changes.
Parous women without history or gross evidence of infection	17	13	4		1*		1	1	1	1* anaerobe. Mixed growth from a case subjected to preliminary intra-uterine manipulation.
Parous women with history or gross evidence of infection	32	23	9	5	2	1	1			One streptococcus case packed to control bleeding two days before operation. All others except diphtheroid bacillus case yielded similar growth from the fallopian tube.

operative diagnosis. Microscopical examination of the scrapings was rarely made and still more rarely recorded. Sometimes variations in diagnosis were noted such as chronic metritis, chronic hyperplasia, subinvolution, etc. Ofttimes the only symptom of these various diseases was a uterine discharge which was manufactured by the cervical mucosa. A very common indication, now discarded or discredited, was incomplete abortion, and if fever was present the operation was considered imperative and of a "life-saving" type. We now know that invasion of the vagina or uterus in such conditions is not only very hazardous but decidedly unnecessary; that, except in case of very dangerous hæmorrhage, such conditions are best treated without such invasion.

As a supposed stimulant, curettage has been often employed in treating uterine hyperplasia. The philosophy of it was illy founded. Cure of cancer of the uterine body has apparently been secured by curettage. Possibly the disease in these instances was so early and superficial as to have been entirely removed by the curette, and yet here we are confronted by many warnings of the danger of cancerous contamination in cutting surgical operations for this disease. Ignoring these well founded warnings, one can scarcely lay claim to such refinement in pre-operative diagnosis as to be able to select cases for such treatment of cancer of the uterine body. In metrorrhagia incident to retroversion of the uterus, it is common practice to curette without effort to right the malposition. In this type of hæmorrhage the use of a proper pessary is usually ample treatment. In other uterine hæmorrhages, from cardiac or other conditions outside the uterus, the curette is too often employed in place of careful study of the causes. Especially is this the case when loss of endocrine equilibrium is the cause.

DANGERS

It is well to point out the many dangers incident to uterine curettage. Not infrequently is a pregnancy in its first month thus scraped from the uterus and perhaps never recognized. Certainly humiliation has often come to the operator by discovering during curettage that an unsuspected pregnancy has been interrupted. Very often, too, pregnancy has unnecessarily been ended by curettage for incomplete abortion. The literature teems with reports of cases of perforation of the uterus by the curette with or without dangerous sequelæ and even death. In the *Index Catalogue* mentioned are found titles like these: "Resection of 70 Inches of Intestine after Perforation of the Uterus with the Curette"; "Perforation of the Puerperal Uterus: Pelvic Peritonitis; Drainage of Uterus and Parametrium; Colpotomy; Recovery"; "Two Cases of Death Following Curettage with Perforation of the Uterus"; "Laparotomy Three Hours after Curettage and Perforation of the Uterus; Seventeen Centimeters of Gut Drawn out of the Uterine Cavity; Uterine Wound Closed: Recovery." Infection plays a major part in the fatal cases usually and to a lesser degree in the remaining ones. For various and ofttimes obvious reasons by far the larger number of such perforations are not published. Nor are they, by any means, confined to the unskilful operator. Often infection without perforation is a sequel and often latent tubal infection is thus aroused to activity.

"Hyperpyrexia Following Curettage of the Uterus" is another title found in medical literature and is quite *à propos*.

How often curettage brings away a premenstrual thick membrane that brings from the pathologist a report of chronic endometritis! Close questioning of the latter brings slow admission that no genuine characteristics of existing inflammation were present. But the surgeon is cheered by the confirmation of his diagnosis and he has no doubt of correctness of both diagnosis and treatment. The invaluable paper of Arthur H. Curtis furnishes much valuable information concerning the bacteriology of the endometrium with and without instrumentation of it and I take the liberty of copying his table of results.

We find in this table that in 26 nullipara, *without* history or gross evidence of infection, 23 gave no growths from the endometrium and in 2 of the 3 furnishing growths, mixed infection was found. These two patients had been curetted a few days before.

In 13 nullipara *with* history or gross evidence of infection but one showed a growth—the gonococcus.

In 47 parous women *without* history or gross evidence of infection but 4 showed growths. In 1 of these, a prolapsed uterus removed *per vaginam*, a few colonies of short gram-negative were found scattered among several tubes of media—probably from contamination in operation. Another showed contamination by diphtheroid bacilli, leaving but 2 cases for consideration. In 1 of these curettage and dilatation were done as a preliminary to hysterectomy. In the remaining case curettage was done 7 years before for persistent bleeding following spontaneous abortion. Thirteen months before hysterectomy, bleeding again ensued and became a constant oozing. In this case were found numerous pus cells and several colonies of anaerobic streptococci in pure culture.

In 32 cases of parous women *with* history or gross evidence of infection, 9 showed growths. One case, with hæmolytic streptococci in cultures, had been packed to control hæmorrhage 2 days before hysterectomy. One other, opened at operation, furnished only diphtheroid bacilli. Eliminating these 2 cases, 7 infected ones remain, of which 5 showed chronic gonorrhœal infection in endometrium and tubes, and 1 nonhæmolyzing streptococci in endometrium and tubes.

Curtis concludes that the endometrium of nullipara, without history or gross evidence of pelvic infection, is almost invariably free from bacteria and microscopically normal. That almost all women who have undergone normal pregnancy, with pelvic history otherwise negative, likewise possess bacteria-free endometria. That patients with a history of chronic infection, from whose endometria bacteria are obtainable, almost all have salpingitis with equally good growth and, that pyometra and recent exploration of the uterus excepted, the endometrium almost never shows bacteria except when there is infection of adjacent pelvic tissues and that chronic endometritis, *per se*, with bacteria present in smears or cultures, is practically to be ruled out as a clinical entity.

Such data indicts the curette and other instruments when introduced through the cervical canal into the uterine cavity. The cervical canal is so constantly infected that it does not seem strange, infection may be carried from it into the uterine cavity by curette, sound or dilator. Again, it is shown by Curtis that infection of the endometrium is nearly always associated with similar infection of the tubes and most often gonorrhœal. Curettement under such conditions is strongly contra-indicated. It would seem, then, the dangers from curettage are ever present, whether in the hands of the skilled surgeon or in those of his less fortunate confrère, or of the midwife, and should be practically excluded from the infected uterus. If chronic endometritis as a clinical entity is to be ruled out, one potent indication for curettage in the past will be removed.

If bringing this subject to your attention will appeal successfully to your aid in bringing about harmony between the use of the uterine curette and the teaching of gynecological pathology and bacteriology, I will be deeply gratified.

MODERN METHODS IN THE REMOVAL OF PROJECTILES[1]

By R. ATKINSON STONEY, F.R.C.S.I., Dublin, Ireland
Visiting Surgeon, Royal City of Dublin Hospital; Late Consulting and Operating Surgeon 5th Section 17th Region
AND
ARNOLD K. HENRY, F.R.C.S.I., Dublin, Ireland
Late Consulting and Operating Surgeon, 5th Section, 17th Region

IN the summer of 1918 our hospital in France was provided with the surgical X-ray cabinet of Dr. Ledoux Lebard and box tube-carrier of Teillar working on wooden tracks under an aluminium operating table. We at once made use of this apparatus for the removal of foreign bodies under direct vision of the X-rays. Hitherto we had had to do this work with the help of the vibrator of Bergonié and X-ray plates taken at the neighboring military hospital. We fitted up our X-ray plant in the anæsthetic room which opened off the theater and by means of a long cable for the electric current, we were able to place the X-ray cabinet in the theater itself. The tube under the special operating table was connected up to the X-ray cabinet by heavily insulated cables. To avoid having to darken the theater or work in an artificial red light as recommended by Bergonié, we used the bonnet of Dessane. In this, when the anterior part of the bonnet is lifted, a screen of dark red glass automatically closes the aperture of the eyepiece.

There are two distinct methods in which this bonnet may be used: (1) The foreign body having been previously localized, the operator commences the operation and when he has reached the region where the foreign body is supposed to lie, he has the bonnet put on his head, and after pausing a couple of minutes to accommodate his eyes, the X-rays are turned on, and with a probe or blunt dissector, he works through the tissues until he reaches the foreign body, which he may then remove, under the rays, with forceps; or having taken off the bonnet, while the guide is left in position, he may dissect down to the foreign body and remove it by ordinary sight. When there is difficulty in reaching or removing the foreign body, a certain amount of dissection can be done, without removing the bonnet and so losing the accommodation, through the red glass screen which comes into place when the front of the bonnet is lifted. But for this purpose the lighting of the theater must be very good, and it is not safe to attempt fine dissection in the neighborhood of important structures. (2) In the second method the assistant wears the bonnet, and points out the position of the foreign body in relation to the surface, and continues to do so during the various stages of the operation until the foreign body is finally reached. This method is better adapted to those cases in which there are several foreign bodies or in which the object lies in close relation to important organs, necessitating much fine dissection. By a modification of these two methods, the incision is made by the assistant, and the operator wearing the mask, works by direct vision with the rays, using a probe, blunt dissector, or forceps. We used all of these methods in suitable cases with very satisfactory results; and it was most noticeable, although perhaps not so surprising, how easily and through what comparatively small incisions foreign bodies could be removed when deeply situated and in almost any part of the body. The advantage of this method is specially noticeable when the foreign body is situated in bone, as by touch it is practically impossible in most cases to tell the difference between the sensation given when an instrument is in contact with a piece of metal or a rough piece of bone. We have had no experience in the use of the telephone probe, which of course would do away with this difficulty.

The electric vibrator of M. Bergonié proved in our hands a most efficient instrument in suitably selected cases. The principle on which it works is that when an alternating electric current is passed through an electromagnet, vibrations are set up in magnetic bodies in its neighborhood. This vibration can be recognized through a considerable depth of tissues, even when the foreign body is comparatively small; thus the vibration of a small shell splinter not larger than 2 millimeters in its greatest diameter can be recognized, even though the piece of metal is situated at a depth of over an inch in the soft tissues. This apparatus is most useful for pieces of shell, as steel or iron respond powerfully to the electromagnet. Bullets with their metal casing also vibrate fairly well. It is, of course, useless for leaden objects, such as shrapnel bullets or the core of rifle or machine-gun bullets, also particles of certain grenades and bombs. With the help of this instrument we removed large numbers of foreign bodies, some comparatively

[1] Read before the Surgical Section of the Royal Academy of Medicine in Ireland, November 21, 1919.

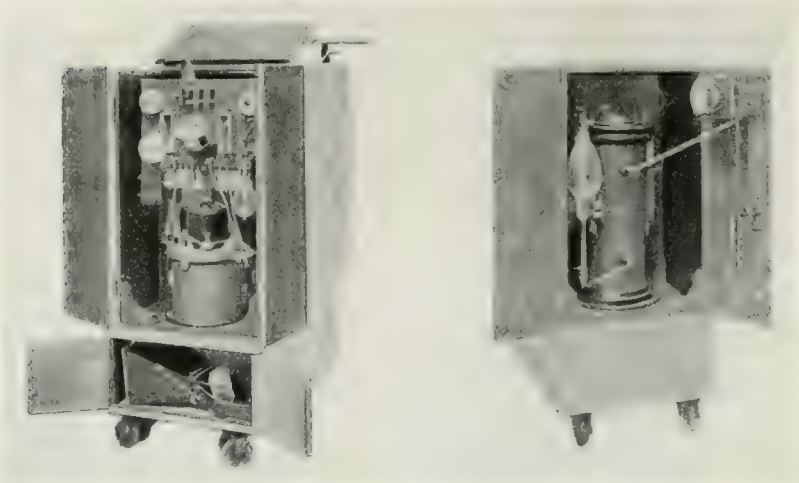

Fig. 1. Surgical X-ray cabinet of Ledoux Lebard. At left, posterior view; at right, anterior view.

deeply situated in the body as in Case 11. Its use is simple in the extreme. The point on the skin where the maximum vibration is felt, is marked, and an incision is made and deepened until the projectile is found; if this cannot be accomplished quickly, the vibrator is brought over the wound, enveloped in a sterilized towel to prevent infection, and the current is again turned on while a finger is kept in the wound. The vibrating body can then be distinctly felt and accurately localized. It is necessary before doing this to remove all metal instruments from field of operation to prevent confusion by the vibrations imparted to them. M. Bergonié has, however, succeeded in having instruments made of an alloy which is not affected by the vibrator.

The following are brief records of some of the more interesting cases. Some of them had already been operated on unsuccessfully at other hospitals, and others had been advised against operation owing to the supposed difficulty or danger. We made the rule that every foreign body should be removed, if the patient consented, provided that the operation did not appear likely to endanger life, or cause permanent injury. The only case in which we refused operation, was that of a soldier who had been wounded by a small shell splinter in the chest, and the X-rays showed a piece of metal the size of a grain of corn, lying in contact with the arch of the aorta, the pulsations of which were transmitted to it. In this case, as there were no symptoms, it was decided that the operation, however interesting, was not worth the inevitable risk.

The danger of X-ray burns is quite negligible, as in most cases the exposure need not exceed 5 minutes, and even this is not continuous, as the current may be shut off from time to time. There might, of course, be a real danger to the operator's hands if a great deal of this work were done continuously.

Case 1. C. P.; soldier, age 33; admitted June 2, 1918; wounded by bullet, May 31, 1918. When admitted the patient presented a comminuted fracture of the lower third of the right humerus, with extensive wounds which were closed by secondary suture. The fracture consolidated well. A roentgenogram showed a slightly deformed bullet in front of the middle of the elbow-joint, close to the bones. Owing to the flexed position of the elbow, it was very difficult to localize the bullet exactly by X-ray photographs. There was also a piece of metal lying behind the upper part of the ulna. Neither piece of metal was perceptibly affected by the vibrator. Operation was performed, August 20, 1918. An oblique incision was made over the front of the elbow-joint in the line of the brachial artery. The wound was deepened between the artery and the tendon of the biceps, then the operator put on the X-ray bonnet, and a blunt dissector was pushed into the tissues through the incision until it was seen to be in contact with the bullet. The bonnet was removed and the dissector was left in position. The opening in the brachialis anticus through which the instrument passed was then enlarged, and the bullet which was lying in contact with the capsule of the joint and directly behind the brachial artery, was removed with forceps. The wound was closed.

A second incision was made behind and to the inner side of the upper end of the ulna. The X-ray bonnet was put on, and by sight the blunt dissector was pushed into the muscles and contact secured with the piece of metal, which was the size of a small pea. The projectile was lifted out on the blunt dissector, still under view by the rays. The wounds healed rapidly.

Case 2. C. G.; admitted July 9, 1918, wounded May 28, 1918 by a shell splinter. The patient had a large healed

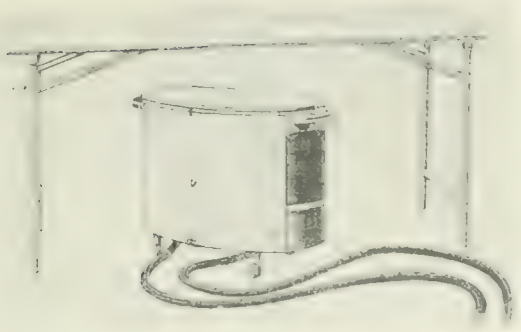

Fig. 2. Box tube-carrier of Teillar, with insulated cables and operating table. (The rails and sliding carrier are not shown

Fig. 3. Bonnet of Dessane, closed.
Fig. 4. Bonnet of Dessane with front raised.

wound on the inner border of the right foot and the X-rays showed a foreign body in the second right tarsometatarsal joint. An attempt had been previously made to extract it. An incision was made along the course of the wound and the sole of the foot was placed flat on the table. The operator donned the X-ray bonnet, and by direct vision pushed a blunt dissector in through the incision until it was seen to be in contact with the piece of metal. It could not be recognized by touch as it was surrounded with rough bone. The blunt dissector was worked around the foreign body until the latter was loosened; then a forceps was passed into the wound, still under the rays, and made to grasp the shell splinter which was then removed. The wound was packed with "bipp" gauze and healed rapidly.

Case 3. L. M.; admitted August 6, 1918; wounded July 20, by a bullet which entered the outside of left thigh just below the anterior superior spine, then passing through the bladder, lodged in the right side of the pelvis and was shown by the X-rays embedded in the bone under the iliopectineal line on a level with the acetabulum. Operation was performed on September 14, 1918. An incision was made from just inside the right anterior superior spine to the middle of Poupart's ligament, the muscles were divided and then the abdominal fascia, and by blunt dissection the incision was carried down to the pelvic brim, the iliac vessels being displaced inward. The operator donned the X-ray bonnet, and after some searching a hole in the bone was felt with a blunt dissector, under the iliopectineal ridge. Owing to this ridge it was necessary to work round an angle, and as it was the point of the bullet which presented in the hole it was found impossible to grasp it in a forceps in spite of repeated efforts. The operator therefore removed the bonnet, and with a gouge cut away the overhanging edge of bone. He then put on the bonnet and with the blunt dissector loosened the bullet and removed it in the grasp of a forceps. The wound was closed and healed quickly, and the patient left the hospital well, within a month of the operation.

Case 4. A. B.; soldier; had a revolver bullet lodged in the right foot between the anterior extremity of the os calcis, scaphoid, and astragalus. It had entered from the dorsum. The wound of entry was healed. By the help of X-ray plates taken in two positions an unsuccessful attempt had been made at another hospital to remove the bullet by lateral incisions on either border of the foot. Operation was performed on September 14, 1918. The internal incision, previously made, was opened up. The operator now put on the bonnet. The sole of the foot was placed flat on the table and a blunt dissector pushed in until the bullet was reached and loosened; here it was impossible, owing to the surrounding bone, to recognize the bullet by feel. The bullet was removed with the forceps.

Case 5. H. S.; a soldier; was hit by a small piece of shrapnel in the front of the middle of the right thigh. The wound was healed and an X-ray plate taken antero-posteriorly showed a foreign body a little to the outer side of the bone. An attempt was made to reach it by following the cicatricial track, but it failed. On October 8, 1918, he was anæsthetized on the X-ray examination table. Even with the bonnet on, it was difficult to see the foreign body owing to its minute size, but it was finally reached with a probe, loosened and then removed in the grasp of a forceps; it was situated close to the postero-external aspect of the femur and was only 1.5 millimeters in diameter.

Case 6. M. M.; admitted October 13, 1918; wounded July 23, 1918, by a shell splinter which entered in the left lumbar region and lodged in the left chest. By the X-rays the splinter was localized under the left fifth rib between the nipple and anterior axillary lines. There was no movement with respiration. An unsuccessful attempt had been made to remove it at another hospital. The foreign body was carefully localized by the screen on the operating table. A portion of the fifth rib was removed and the shell splinter 1.5 by 1.75 by .75 centimeters was at once seen lying in a small cavity outside the pleura. It was removed and the wound closed. In this case it was expected that it would be necessary to use the X-ray bonnet after the removal of the rib, but there was no need as the piece of metal was visible.

Case 7. L. R.: admitted October 2, 1918; wounded May 29, 1918. This soldier had been wounded in the left knee and the X-ray showed a small piece of shell embedded in the back of the internal condyle of the left femur. He himself demanded its removal. On October 16, 1918, an incision was made vertically over the posterior part of the inner side of the knee, and the internal condyle was exposed without opening the joint. The operator put on the X-ray bonnet and marked the point on the bone under which the foreign body lay. A small hole was made in the bone with a gouge and a blunt dissector pushed into the cancellous tissue. An attempt was made to reach the splinter but failed; then with the knee turned on its outer side, the operator wearing the bonnet worked a small curved gouge through the cancellous bone until the shell splinter was reached, when it was loosened and removed. The foreign body measured 3 by 2.5 by 1.5 millimeters.

Case 8. L. D.; admitted October 23, 1918; wounded July 18, by a bullet which entered the back of the left chest, close to the outer border of the scapula, smashing a rib; it was shown by the X-rays to be lying on the right side of the chest deep to the seventh rib, just external to

Fig. 5. Use of vibrator of M. Bergonié during operation.

its angle about 5 centimeters from the posterior skin surface. There was no movement of the bullet with respiration and it was hoped that it lay between the rib and the pleura. At the operation an incision was made along the course of the seventh rib, and 1.5 inches of it were removed, 2 inches from the angle. The operator donned the X-ray bonnet, and the bullet was plainly seen, but it could not be palpated or made to move by pressure in the wound. The operator removed the bonnet and incised the pleura. The lung was found to be adherent and a small incision was made in the altered lung tissue. The bonnet was again put on and a probe passed into the wound. At this moment the electric current failed, and on telephoning to the electric station it was found that there was a short circuit on the line which would take a couple of hours to repair. The operation was continued, therefore, without the rays, and by blunt dissection the wound in the lung tissue was carefully deepened and the bullet was found and removed from a depth of 4 centimeters. There was very little oozing of blood and the wound was "bipped" and closed. There was very slight hæmoptysis for the first 12 hours; the wound healed by first intention and the patient left the hospital a fortnight after the operation.

Case 9. J. B.; admitted October 4, 1918; wounded September 25, 1918, by shell splinter. This soldier showed a small foreign body deeply situated in the right axilla. A half inch incision was made, and under the screen a blunt dissector was pushed in until it was seen to be in contact with the piece of metal. Then a Kocher forceps was passed in and the steel splinter grasped and removed. The whole operation took only about 3 minutes, and the incision was closed by one Michel clip. Convalescence was completed in a week. Under ordinary methods, this would have required an extensive dissection of the axilla, as the foreign body was situated close to the vessels and the nerves of the brachial plexus.

Case 10. Admitted November 16, 1918; wounded July 29, 1918, by explosive bullet. This soldier had a comminuted fracture of the middle of the right tibia. On admission the fracture was unconsolidated and the X-ray showed numerous fragments of metal in the seat of the fracture. At the operation on November 29, 1918, the wound on the outside of the front of the leg was enlarged, and the hard bare ends of the upper and lower fragments exposed. A fair sized central sequestrum was removed. The operator put on the X-ray bonnet and three fairly large pieces of the mantle of the bullet were removed and three very small pieces of lead, all from the line of the fracture itself, with practically no disturbance to the bone ends, which were partially embedded in callus developing on the back of the bone. Some more sequestra were removed and the whole area cleaned with ether and "bipp" and packed with "bipp" gauze.

Fig. 6. Operation under direct vision by X-rays with bonnet of Dessane covered by sterilized towel

Case 11. J. F.; admitted September 27, 1918; wounded May 21, 1918, by splinter of aerial torpedo. This soldier had a healed wound to the right side of the second dorsal vertebra. On examination with the rays, a large shell splinter was seen between the last rib and the crest of the ilium on the right side. Distinct movement was felt under the vibrator.

Operation was performed on October 11, 1918. An oblique incision was made, as for a lumbar exploration of the kidney, between the last rib and the crest of the ilium, and the muscles were divided. The vibrator was then applied and a faint vibration could be felt deep to the anterior portion of the wound. By careful, blunt dissection the tissues were divided until a large piece of metal 2 by 1 by 1.5 centimeters was found in a small cavity. This was removed, the cavity cleaned with "bipp" and the wound sewed in layers. It appeared to be outside the kidney in the loose tissue behind the ascending colon. He had been advised at Paris not to undergo an operation for removal.

Case 12. M. M.; admitted July 2, 1918; wounded May 27, 1918, by bullet. This soldier was hit by a bullet just to the right of the second lumbar spine. The bullet lodged in the right side and could be seen by the X-rays, lying apparently under the last rib at a depth of 5 centimeters from the skin of the back. There was a distinct vibration felt under the vibrator. On July 3, 1918, an incision was made obliquely along the lower border of the eleventh rib, the muscles were divided, and the extraperitoneal space opened. A hard object was felt and was

shown by the vibrator to be the bullet. The fibrous capsule was divided and the bullet extracted. The cavity was "bipped" and the wound closed. This operation which had been advised against in Paris, was performed in less than 15 minutes without the aid of an assistant.

Case 13. Twenty-seven minute fragments of grenade in left hand. The patient had been wounded in the left hand by a bursting grenade one month previously. All his wounds were cicatrized, but he complained of diffuse tenderness over the sides and front of the little and ring fingers at their bases, and over the hypothenar and thenar eminence. A roentgenogram showed these areas speckled with minute metallic fragments which gave no vibration with M. Bergonié's instrument. At operation all these were removed, one operator localizing them with the radioscope and using a needle as a pointer, the other using the knife and extracting the fragments. Except on the radial side of the little finger and at its base where two long incisions enabled us to reach 8 fragments, the foreign bodies were removed through quarter-inch cuts. So clear was the radioscopic picture that after the removal of a fragment, it was possible to distinguish the faint shadow of metallic staining which marked the position it had occupied. Twenty-seven small curled scales of metal were rapidly extracted. Eleven of these scales were each a little larger than a pin's head; the remaining 16 were more minute. The wounds healed normally and tenderness completely disappeared from the hand. This operation if attempted by any other than the direct radioscopic method would probably have been incomplete, or if complete, mutilating.

Case 14. Shell splinters in the tibia. The patient had been wounded 2 months previously by a shell. The wound at the lower end of the right tibia was healed, but the patient had a fear of latent sepsis, and desired removal of the splinters. The radioscope showed that 3 of the fragments were included in the tibia just deep to its inner aspect. There was also a larger fragment in the soft tissues between the external malleolus and the astragalus. This was removed first, a probe, after incision, being thrust into contact with it under the guidance of the radioscope. Through a second short incision a small opening in the tibia was then made with a gouge, and 3 projectiles, the largest half an inch in length, were removed from a cavity a fourth of an inch deep to the inner surface of the bone. This extraction was easily and rapidly effected with the aid of the radioscope, in spite of the fact that the fragments were embedded in the wall of the cavity and although the opening in the bone was so small as to prevent direct observation of their position. The two wounds which were "bipped" and sutured in layers, healed normally, and the patient was discharged 14 days after operation.

Case 15. Three shell splinters in the os calcis. The patient presented a cicatrized wound in the left foot which had been received 8 weeks previously but he desired the removal of the metal fragments. One projectile was observed with the radioscope and a 1.5 inch incision parallel to the long axis of the os calcis was made over its outer side. The bone was opened with a gouge and the projectile, a quarter inch cube was found encrusted in the wall of a small cavity at a depth of half an inch from the bone-surface. It was removed, and two other scale-like fragments, each the size of a pin's head, were seen also to be fixed in the cavity. These were easily dislodged, but were less easily extracted, both on account of their minuteness and because of the tendency of their shadows to become linear when they were moved and so to vanish in the shadow of the bone. These two fragments were taken out with a curette. The wound was "bipped" and sutured in layers. Cicatrization was normal.

Note.—In these two cases of intra-osseous projectiles, Cases 14 and 15, one operator made the incision and opened the bone; the other, wearing the radioscopic bonnet, localized the projectiles and extracted them.

Case 16. The patient had been wounded about 8 weeks previously, by a shell fragment and presented a small scar in the lower dorsal region of the left side. A preliminary examination revealed a projectile in the posterior part of the left hemi-thorax at the level of the eighth rib, near its angle. At operation the shadow of the projectile was seen with the radioscope, at first vaguely owing to weakness of current, but presently a clear shadow appeared and a 3-inch vertical incision was made 3 inches from the spines of the vertebra.

Under radioscopic control the thickened and adherent pleura was incised vertically, between the eighth and ninth ribs, and a closed forceps pushed gently through the adherent lung in contact with the projectile which was extracted with scarcely any hæmorrhage from the fibrotic lung-tissue in which it lay. The wound was then "bipped" and sutured in layers. Except for the fact that the patient's sputum on the evening of operation was slightly tinged with blood, recovery was uneventful, and he was discharged 14 days afterward.

Case 17. Shell fragment in a bilocular intraperitoneal abscess. The patient had been wounded 6 weeks previous to admission. He presented a small scar on the right loin, 1.5 inches below the middle of the twelfth rib, and a roentgenograph sent with him showed a projectile in this region. He was very thin. He had loss of appetite, diarrhœa, abdominal pain of a colic-like nature, epigastric tenderness, and a fluctuating temperature. He did not vomit. The upper abdomen was resistant rather than rigid and gave no dullness on percussion.

At operation under radioscopic control, a 2.5 inch incision was made parallel to the twelfth rib. This incision was carefully deepened and a closed sinus forceps was passed into contact with the projectile at a depth of 2.5 inches from the surface. At the moment of contact there was an escape of over an ounce of pus, and the shadow of the projectile moved suddenly across the radioscopic screen and was covered for a moment by the shadow of the twelfth rib.

Then, as suddenly, it reappeared in the unshadowed field. In attempting to regain contact with it, the forceps opened a second and much larger abscess cavity from which 2 pints of odorless pus escaped and once more the projectile-shadow was seen to move. The smaller cavity was the hepatorenal pouch, and the finger introduced between the right kidney and the liver could be passed through an aperture into the larger cavity beyond. This was probably either the distended lesser sac or the subhepatic space. By careful manipulation of a long sinus forceps the observer with the radioscope was able to regain contact with the projectile in the larger cavity at a depth of 6 inches from the lumbar surface and at a point which must have been close to the anterior abdominal wall. The projectile was then extracted. It was the size of a finger-nail and one-eighth of an inch in thickness.

The bilocular cavity was washed out with 3 liters of Dakin's solution and then packed with "bipped" gauze for 48 hours. The patient recovered rapidly but his stay in hospital was prolonged by the persistence of a sinus leading to an intramuscular pocket in the abdominal wall. This pocket was curetted and "bipped," and the patient was discharged 2 months after the first intervention.

Without direct observation of its shadow during the operation, the innocuous extraction of this elusive projectile through a small incision would have been almost a miracle.

EDITORIAL

NECESSARY INCREASE IN THE SUBSCRIPTION PRICE OF THIS JOURNAL

THE burden of increasing costs in the publication of this journal has become so great that we are now obliged to ask our subscribers to approve an increased subscription rate in order to insure its continuation on the same plane of excellence as in the past.

SURGERY, GYNECOLOGY AND OBSTETRICS was founded fifteen years ago by a group of surgeons, with the idea that there was need for a high class special journal which should cover the broad field of surgery in all its specialties. They had no idea of making it a money-making enterprise, and its earnings from year to year have been utilized to publish a better and a larger journal. It has achieved a leading place among the special journals of the world and today has a paid subscription list in excess of 11,500, a circulation far greater than that of any other similar publication.

Since the outbreak of the European war in 1914 and particularly since the entry of the United States into the war, manufacturing costs have increased enormously. Printing costs have more than doubled, being at this date approximately 107 per cent more than in 1914. The cost of paper has trebled. Ten tons per month are required, costing now from 15 to 22½ cents per pound as compared with pre-war prices of 4½ to 7 cents. Likewise, all other costs have greatly increased during the same period, and the point has been reached where the expenses of publishing this journal exceed the gross receipts from subscriptions and advertising. In addition, still further increases in the cost of both paper and printing are to be met.

In many respects SURGERY, GYNECOLOGY AND OBSTETRICS differs from most other publications. In the first place, it is more largely dependent upon subscriptions than the average journal, as four-fifths of the money that goes to meet publication expenses is derived from subscriptions and only one-fifth from advertising. Secondly, the publication of the ABSTRACT, which comprises one-half the complete edition, entails a large expenditure for translating, abstracting, and editing—an expense unusual to most medical journals. Another unusually heavy item of expense is due to the number and quality of the illustrations used—in respect to which we feel any reduction would seriously impair the value of our publication.

Effective July 1, 1920, therefore, the subscription price of the complete edition, which includes the INTERNATIONAL ABSTRACT OF SURGERY, will be $12.00 per annum to subscribers residing in the United States, Canada, and all points where domestic postage rates apply. To subscribers residing in foreign countries the subscription price will be $14.00. For the special cloth edition the rate will be increased proportionately.

Franklin H. Martin

MANAGING EDITOR.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting January 16, 1920, with Dr. A. H. Curtis, President, Presiding

OVARIAN CYST AND TWISTED PEDICLE IN CHILD OF 12

Dr. Mark Goldstine: This case is only important from the standpoint of the age of the patient. The little girl was 12 years and 9 months old, and never menstruated apparently, although a healthy child. She was admitted to Wesley Memorial Hospital on the first of October, 1919. At that time she had a temperature of 99.8°, with a pulse of 120, and a leucocyte count of 27,000. Two months before this she had some attack which began with a sharp pain in the right lower abdomen which lasted two hours. The physician at that time made no diagnosis. On September 29, she had a recurrence of pain in the same region which did not appear to become worse. On admission to the hospital she had what we thought was a typical ruptured appendix. I operated upon her for a ruptured appendix and found an innocent appendix, and on exploring further I found an ovarian cyst with twisted pedicle, the pedicle being twisted two or three times from left to right.

ANURIA FOLLOWING BLOOD TRANSFUSION

Dr. Arthur H. Curtis: I would like to report a case which is now in my service at St. Luke's Hospital. The patient, a young woman, recently married, came from Michigan two weeks ago. She had a marked anæmia, with about 30 per cent hæmoglobin, due to bleeding from a uterine fibroid. Her condition was so precarious that it was impossible to operate, and so serious that it seemed advisable to give her blood transfusion. Under favorable conditions we performed transfusion by the citrate method which progressed very favorably. It was done in a manner similar to other transfusions by the same method. The patient developed anuria immediately following transfusion, although the blood of the donor was tested with that of the patient and apparently was perfectly compatible. The patient developed some hæmaturia, had a chill, with an extremely rapid pulse, and a great deal of pain in the back immediately after transfusion, followed by the anuria which I have mentioned. During the 24 hours, as I recall it, following her transfusion, there was passed only 1 ounce of urine. In the succeeding 3 days the patient passed respectively 3 ounces of urine, 1 ounce of urine, and 2 ounces of urine. The urine showed only a trace of albumin, an occasional cast; but it was normal in other respects. The blood urea was enormously high, amounting to 100 milligrams per hundred cubic centimeters. The patient is now gradually recovering. I present a description of this case with the hope that you may have some explanation for the anuria which followed transfusion. It seems to me very likely that it was the result of the transfusion, and not the result of the anæmia.

THE POSTMATURE CHILD

Dr. Charles B. Reed read a paper on the postmature child. (See page 580.)

DISCUSSION

Dr. Carey Culbertson: I have always felt it was quite as difficult to save a postmature child as a premature one, if indeed it is not more difficult. A premature child is far enough advanced in its physiology to take and assimilate food and stands a good chance of thriving in an incubator. A postmature child is lost in labor as the result of difficulties in delivery. The postmature child is definitely an overgrown child, and if too large to pass through the pelvis without considerable assistance can be delivered safely by cæsarean section alone. In this respect only is the matter of saving it a simple one.

In my experience this is one of the real problems at the end of pregnancy that requires judgment; and under certain circumstances we are not always sure of that judgment, as has been brought out by Dr. Reed in his closing statement. It is a question which I think has been ably and properly presented before the society at this time, a question which confronts every one of us who practices obstetrics. I think every man who has had any considerable experience has had one or more of these cases of definite postmaturity, where the problem of delivery has become increasingly serious as the case has gone further into labor, resulting not only in extensive impairment of the maternal structures, but as well in the damage that is done to the child, often fatal. For this reason there is much to say in favor of Dr. Reed's position with respect to arbitrary

induction of labor at term where maturity of the child is unquestioned.

Dr. Charles S. Bacon: I have been impressed with the advocacy of interference by Dr. Reed in these cases, but not exactly convinced. I know that there have been some statistics showing the increased dangers of large and postmature children, but I do not know that they are as numerous as may be desirable to settle this question more definitely. Suppose all of us in our work kept careful records of the children that may be called postmature, with the results of noninterference, and suppose those results compared very favorably with those produced by interference; it might help a little to enable us to agree.

Judging from the date of conception and the date of fœtal movements, and so on, I have had a number of cases that have gone from 300 to 320 days and have had fairly normal spontaneous delivery, and my own limited experience does not make me feel the anxiety that I should have were there more statistics to rely on. The tendency, I think, in recent years has been to rely upon noninterference in contracted pelves — at least, in primiparæ, and it seems lacking in the other direction where there is interference simply because there is some increase in the size and weight of the child.

Dr. Joseph L. Baer: I should like to ask Dr. Reed whether in measuring the height of the fundus in centimeters he uses the hair-line measurement or the circle; in other words, whether it is a caliper measurement or tape applied to the abdomen and following the curve of the abdomen. I find 33 to be a distinctly short measurement for a full-term uterus, and 35 a reasonable average. I am interested to know the method the essayist uses in obtaining that measurement.

I am also interested to know whether Dr. Reed is prepared to give us an accurate statement of the antepartum and postpartum comparisons of measurements of the head. Personally, I have relied on the relation of the head to the pelvic inlet at the time of supposed maturity. In other words, if the patient reaches term and does not go into labor, I subject her to a bimanual examination and directly force the head toward the pelvic inlet and into it. If there is no evident maladjustment, I wait for adjustment. If the head meets with bony resistance, I would seriously think of interference regardless of the measurements of the head intra-uterine or at the height of the fundus.

Dr. Theodore J. Doederlein: I would like to ask Dr. Reed what results he had with percentage diet.

Dr. Reed (closing): In regard to Dr. Doederlein's question concerning percentage diet, I have had three cases on a percentage diet which I thought were satisfactory, but they dropped out of sight before I could finish.

In regard to Dr. Baer's question of measurements I use a tape which passes from the upper border of the symphysis over the rotundity of the uterus and into the sulcus behind the fundus, but not clear down. I carry the tape to the edge of the finger, so that the finger makes the edge of the fundus which gives me the length.

Dr. Baer asked in regard to measurements of the fœtal head. The Muller manœuver he describes I used for a number of years, but I found it so painful unless an anæsthetic were given that I have not used it much of late. In regard to the measurements, I have omitted them here, I have given them before.

TYPES OF PELVIC INFECTION

Dr. Theodore J. Doederlein read a paper entitled "Types of Pelvic Infection." (See p. 599.)

DISCUSSION

Dr. Emil Ries: The most interesting part of the paper of Dr. Doederlein to me was the reference to survival of infections in the female sexual tract.

During the recent war a good many observations were published where surgeons operated on extremities which had apparently recovered from infected injuries and required some plastic work, and where immediately after the operation infection flared up, sometimes with serious results.

It would, of course, clinch the matter if at time of operation streptococci had been found in these tubes, and Dr. Doederlein did not mention that. As long as streptococci have not been found in the organs removed during operation, there is always the possibility of streptococci having been introduced during the course of operation. In the best regulated clinics it has happened that after an apparently simple operation acute streptococcic infection has killed the patient. I remember that a couple of years ago I was in an eastern clinic, where the chief of the clinic was very much upset because after a simple operation for an ordinary chronic salpingitis his patient was dying from a streptococcus peritonitis. He discussed very earnestly the possibility of these streptococci having been in the tubes for years, but could not console himself with that solace, especially as he had examined the tubes bacteriologically, as was the habit in that clinic, and there was nothing found in the tube. He had assumed that the streptococci by some misfortune were introduced in the course of the operation. I am very much interested in that question because such an observation, if clinched by the finding of streptococci in the organs, will be very, very important.

Dr. Carey Culbertson: Dr. Doederlein's paper brings up the old subject of classification of pelvic infection, one I am particularly interested in, because I desire a modern classification of pelvic infections for the purpose of teaching. If we read the textbooks, they still give us the same old clinical groups which do not conform to our modern ideas of infection or of bacteriology.

The two main groups he brought out in detail, that is, the pathology following puerperal infection.

and that following gonorrhœal infection, and he mentioned that pelvic peritonitis develops from the appendix. But there is a group of infections confined to the pelvis wherein the pathology is not characteristic of these types, where the uterus and appendages apparently are not primarily diseased, but where there has been peritonitis about the uterus and appendages, where there are light adhesions, and that too, with no history of puerperal infection, and in some instances no history, even of pregnancy. Likewise there is no history or evidence of gonorrhœal infection. In some cases there is a history of pregnancy or of abortion, but none of infection following abortion. In my mind it is virtually impossible to empty the uterus prematurely, that is, artificially, without some peritoneal reaction sufficient to produce some adhesions. In spontaneous or incomplete abortion such infection is certain to occur. Does this express a light reaction to streptococcus in staphylococcus invasion? On the other hand, where there is no preceding gonorrhœa or puerperal history and we find similar or identical conditions, what is the explanation? Is there such a thing as focal infection producing reaction in the pelvis, infections of the pelvic peritoneum due to some distant infective focus, such as the nasal sinuses, the tonsils, or the teeth?

I am interested in that type of peritonitis that involves the closure of the fimbriæ of the tubes, producing hydrosalpinx, or that kinks the tube by light adhesions, distorting or obstructing its lumen only. In other words, what about the etiology of the so-called catarrhal salpingitis.

Dr. Mark Goldstine: About 4 years ago at Wesley Hospital, Dr. Kanavel and I had a very harrowing experience. He had some very violent infections in I think two or three abdominal cases. Two of them were fatal. These came at the end of an interne service. I got the same interne next, and proceeded to get two very violent infections, one after a simple operation. A violent streptococcus peritonitis developed, followed by death of the patient, and in another, after a hysterectomy, where the patient was violently ill. We decided to take that interne off of the service. We did so. We examined the secretions from the nose of the interne and found that the organisms corresponded with those found in our own cases.

Dr. Doederlein (closing): In answer to Dr. Ries, I will say that the ordinary technique was used, and it is not very likely that such virulent streptococci were introduced during the operation. The tube was not examined for streptococci.

I had another case of puerperal infection, and two years afterward the woman had another cyst which ruptured. She had an enormous peritoneal reaction, but she recovered from operation. She became pregnant, was confined without reaction, recovered, became pregnant again, and had another cyst. This case was very interesting. I was very conservative. It was a torsion cyst and was located above the pubes. I opened it and found the streptococcus. I left the wound open, and drained it. There was such intracystic pressure when I opened the cyst that the contents squirted up above my head. The odor was strong. This attack came about 3 years after the primary abortion. The patient has had a baby since operation.

In answer to Dr. Culbertson, I will say that focal infection occupies a very prominent place in the minds of practitioners today, and although a great deal has been done in investigating the subject I have found nothing in the literature which would answer Dr. Culbertson's queries.

SHORT UMBILICAL CORD

Dr. Charles S. Bacon read a paper on "Short Umbilical Cord." (See p. 597.)

DISCUSSION

Dr. Eugene Cary: I had a patient recently, a para-II, who is still in the hospital and whom I delivered of an eight and three-quarter pound child normally, in which the child, as the previous one had been, was breech for a considerable time, but during the last month of life *in utero* the child was very active and performed spontaneous version, so that we had a vertex. In that time the child evidently had rolled over twice because the cord was around the neck and made a loop in the third roll, so that it crawled through the loop into the cord and tied itself in a true knot. The cord luckily was long enough. The child was delivered. It came down snugly without undoing the coils around its neck, and the child did not suffer from asphyxia. If the cord had been 5 or 10 centimeters shorter, it would have been sufficiently snug to have stopped circulation, and the child would have had died in the last few hours before delivery.

AMERICAN COLLEGE OF SURGEONS

ORGANIZATION OF STATE AND PROVINCIAL CLINICAL SECTIONS

IN accordance with a resolution adopted by the Board of Regents of the American College of Surgeons, providing for the organization of clinical meetings in the several states of the United States and provinces of Canada, the Secretary-General has visited the following states, meeting with the Congressional Representatives at the capital or one of the large cities in each state:

Louisiana	Washington	Missouri
Texas	Idaho	Tennessee
Arizona	Montana	Kentucky
California	Utah	Ohio
Oregon	Colorado	Indiana

In each of the above states the organization of a clinical section was effected, and an Executive Committee elected to carry out the details of the project.

OUTLINE OF ORGANIZATION

1. OBJECT: The organization of state and provincial clinical sections along the lines of the annual Clinical Congresses of the College, each section to hold an annual meeting within the state or province at some convenient time during the year.

2. FORM OF ORGANIZATION: One representative for each Congressional District within the state, and two senatorial representatives at large, each to be elected by the Fellows of the state for a term of two years, one-half of the number to be elected each year. This body to correspond in the state to the Board of Governors of the College.

An Executive Committee for each state, composed of from three to five Fellows, to be elected annually by the representatives of each state. This Committee to correspond to the Board of Regents of the College and to be the supreme executive body in the state. The Executive Committee will make all arrangements for annual meetings, appoint the Committees on Arrangements, and select the meeting place, headquarters, and speakers.

In Canada similar organizations will be effected in each province.

3. MEMBERSHIP: To comprise Fellows of the College and invited guests, the latter to include candidates approved ethically for fellowship in the College by the State Credentials Committee, and to include also internists, pathologists, roentgenologists, sanitarians, and other medical men of influence.

4. PROGRAM: Clinics and clinical demonstrations to be conducted during the mornings by Fellows of the College, and invited associates, of the city in which the meeting is held; afternoon meetings for the laity, to be addressed by invited laymen and surgeons; scientific papers to be presented at evening meetings by local surgeons of prominence or by invited guests from outside the state or province.

In the conduct of these sectional clinical meetings it is the purpose to adhere as closely as possible to the plans which have been universally approved by surgeons who have attended the national Clinical Congresses which have been held in the large cities of the United States during the past ten years.

Close co-operation will be maintained between the state sections and the central executive office of the College, in order that the central organization, through its Board of Regents, may aid in developing the annual sectional clinical meetings.

Following is a list of the Executive Committees and Congressional Representatives elected in the states already organized:

LOUISIANA

EXECUTIVE COMMITTEE
Chairman, Frederick W. Parham, New Orleans
Secretary, Lucian H. Landry, New Orleans
Counselor, Alfred P. Crain, Shreveport

REPRESENTATIVES. Term expiring 1920
Senatorial. William Kohlmann, New Orleans
2nd District, Russell E. Stone, New Orleans
4th " Louis Abramson, Shreveport
6th " Robert Christie Kemp, Baton Rouge
8th " John Luther Wilson, Alexandria

Term expiring 1921
Senatorial. Rudolph Matas, New Orleans
1st District, S. M. D. Clark, New Orleans
3rd " Lewis B. Crawford, Patterson
5th " Archibald B. Nelson, Shreveport
7th " John Greene Martin, Lake Charles

TEXAS

EXECUTIVE COMMITTEE
Chairman, Bacon Saunders, Fort Worth
Secretary, Francis M. Hicks, San Antonio
Counselor, Witten B. Russ, San Antonio

REPRESENTATIVES, Term expiring 1920
Senatorial, Francis M. Hicks, San Antonio
2nd District, George H. Lee, Galveston
4th " E. J. Neathery, Sherman
6th " Andrew B. Small, Dallas
8th " James A. Hill, Houston
10th " Joseph Gilbert, Austin
12th " Bacon Saunders, Fort Worth
14th " Frank Paschal, San Antonio
16th " W. Launcelot Brown, El Paso
At Large, Arthur C. Scott, Temple

Term expiring 1921
Senatorial, John T. Moore, Houston
1st District, Lorenzo P. McCuistion, Paris
3rd " Elbert Dunlap, Dallas
5th " Harold M. Doolittle, Dallas
7th " James E. Thompson, Galveston
9th " John W. Burns, Cuero
11th " Kenneth H. Aynesworth, Waco
13th " Jacob E. Gilcreest, Gainesville
15th " Witten B. Russ, San Antonio
At Large, Edward H. Cary, Dallas

ARIZONA

EXECUTIVE COMMITTEE
Chairman, Winfred Wylie, Phoenix
Secretary, William A. Holt, Globe
Counselor, Roderick D. Kennedy, Globe

REPRESENTATIVES, Term expiring 1920
Senatorial, Roderick D. Kennedy, Globe
At Large, George E. Dodge, Tucson

Term expiring 1921
Senatorial, Frederick T. Wright, Douglas
At Large, Winfred Wylie, Phoenix

CALIFORNIA

EXECUTIVE COMMITTEE
Chairman, Henry H. Sherk, Pasadena
Secretary, D. C. Strong, San Bernardino
Counselors, Stanley Stillman, San Francisco
Wallace Irving Terry, San Francisco
Granville Mac Gowan, Los Angeles

REPRESENTATIVES, Term expiring 1920
Senatorial, Wallace Irving Terry, San Francisco
2nd District, Elisha Tolman Gould, Sonora
4th " Harry M. Sherman, San Francisco
6th " E. N. Ewer, Oakland
8th " Rexwald Brown, Santa Barbara
10th " M. L. Moore, Los Angeles
At Large, Stanley Stillman, San Francisco

Term expiring 1921
Senatorial, Edward T. Dillon, Los Angeles
1st District, Charles Clifford Falk, Eureka
3rd " Andrew M. Henderson, Sacramento
5th " Thomas W. Huntington, San Francisco
7th " Allen B. McConnell, Fresno
9th " Henry H. Sherk, Pasadena
11th " H P. Newman, San Diego

OREGON

EXECUTIVE COMMITTEE
Chairman, Alpha E. Rockey, Portland
Secretary, Joseph A. Pettit, Portland
Counselor, George S. Whiteside, Portland

REPRESENTATIVES, Term expiring 1920
Senatorial, Ernest F. Tucker, Portland
2nd District, Alpha E. Rockey, Portland
4th " Andrew C. Smith, Portland

Term expiring 1921
Senatorial, Frank E. Boyden, Pendleton
1st District, Joseph A. Pettit, Portland
3rd " Robert C. Coffey, Portland

WASHINGTON

EXECUTIVE COMMITTEE
Chairman, Park Weed Willis, Seattle
Secretary, George W. Swift, Seattle
Counselor, William F. West, Everett

REPRESENTATIVES, Term expiring 1920
Senatorial, Ivan P. Balabanoff, Tacoma
2nd District, George Monroe Horton, Seattle
4th " Edmund S. West, Yakima
At Large, O. F. Lamson, Seattle

Term expiring 1921
Senatorial, William F. West, Everett
1st District, James B. Eagleson, Seattle
3rd " Horace J. Whitacre, Tacoma
5th " Charles M. Doland, Spokane

IDAHO

EXECUTIVE COMMITTEE
Chairman, E. E. Maxey, Boise
Secretary, William F. Howard Pocatello
Counselor, Clifford M. Cline, Idaho Falls

REPRESENTATIVES, Term expiring 1920
Senatorial, E. E. Maxey, Boise
At Large, Clifford M. Cline, Idaho Falls

Term expiring 1921
Senatorial, Charles W. Shaff, Lewiston
At Large, Charles R. Mowery, Wallace

MONTANA

EXECUTIVE COMMITTEE
Chairman, T. Casey Witherspoon, Butte
Secretary, LeRoy Southmayd, Great Falls
Counselor, Rudolph Horsky, Helena

REPRESENTATIVES, Term expiring 1920
Senatorial, Fred F. Attix, Lewiston
At Large, Robert H. Beach, Glendive

Term expiring 1921
Senatorial, Thomas H. Murray, Butte
At Large, Alfred Karsted, Butte

UTAH

EXECUTIVE COMMITTEE
Chairman, Andrew J. Hosmer, Salt Lake City
Secretary, Frederick Stauffer, Salt Lake City
Counselor, J. W. Aird, Provo

REPRESENTATIVES, Term expiring 1920
Senatorial, Harry N. Mayo, Salt Lake City
2nd District, Andrew J. Hosmer, Salt Lake City

Term expiring 1921
Senatorial, Ralph T. Richards, Salt Lake City
1st District, Robert S. Joyce, Ogden

COLORADO

EXECUTIVE COMMITTEE
Chairman, Walter A. Jayne, Denver
Secretary, Oscar M. Shere, Denver
Counselor, Alexander C. Magruder, Colorado Springs

REPRESENTATIVES, Term expiring 1920
Senatorial, Horace G. Wetherill, Denver
2nd District, L. H. McKinnie, Colorado Springs
4th " Knud Hanson, Grand Junction

Term expiring 1921
Senatorial, Edward Jackson, Denver
1st District, Leonard Freeman, Denver
3rd " William T. H. Baker, Pueblo

MISSOURI

EXECUTIVE COMMITTEE
Chairman, Harvey G. Mudd, St. Louis
Secretary, William H. Luedde, St. Louis
Counselor, Jabez N. Jackson, Kansas City

REPRESENTATIVES, Term expiring 1920
Senatorial, Jabez N. Jackson, Kansas City
2nd District, Richard F. Cook, Carrollton
4th " Jacob Geiger, St. Joseph
6th " Henry Eagle Thomason, Kansas City
8th " Guy Lincoln Noyes, Columbia
10th " George Gellhorn, St. Louis
12th " William H. Luedde, St. Louis
14th " Major G. Seelig, St. Louis
16th " E. F. Yancey, Sedalia

Term expiring 1921
Senatorial, Paul Y. Tupper, St. Louis
1st District, Josiah G. Moore, Mexico
3rd " Daniel Morton, St. Joseph
5th " William J. Frick, Kansas City
7th " Roche W. Hogeboom, Springfield
9th " Frank Joseph Tainter, St. Charles
11th " Harvey G. Mudd, St. Louis
13th " Cyrus E. Burford, St. Louis
15th " Jackson B. Taulbee, Joplin

TENNESSEE

EXECUTIVE COMMITTEE
Chairman, W. A. Bryan, Nashville
Secretary, William D. Haggard, Nashville
Counselor, John M. Maury, Memphis

REPRESENTATIVES, Term expiring 1920
Senatorial, Duncan Eve, Sr., Nashville
2nd District, Albert G. Kern, Knoxville
4th " Rufus E. Fort, Nashville
6th " W. A. Bryan, Nashville
8th " Jere L. Crook, Jackson
10th " Edward C. Ellett, Memphis

Term expiring 1921
Senatorial, Eugene M. Holder, Memphis
1st District, Claude P. Fox, Greenville
3rd " George M. Ellis, Chattanooga
5th " Edward D. Newell, Chattanooga
7th " William D. Haggard, Nashville
9th " John M. Maury, Memphis

KENTUCKY

EXECUTIVE COMMITTEE
Chairman, Lewis S. McMurtry, Louisville
Secretary, Charles W. Hibbitt, Louisville
Counselor, David Barrow, Lexington

REPRESENTATIVES, Term expiring 1920
Senatorial, Arthur T. McCormack, Louisville
2nd District, Daniel M. Griffith, Owensboro
4th " Robert C. McChord, Lebanon
6th " Robert W. Bledsoe, Covington
8th " John Rice Cowan, Danville
10th " Frank Thomas Fort, Louisville
At Large, Henry Horace Grant, Louisville

Term expiring 1921
Senatorial, Bernard Asman, Louisville
1st District, Frank Boyd, Paducah
3rd " John Henry Blackburn, Bowling Green
5th " J. Garland Sherrill, Louisville
7th " David Barrow, Lexington
9th " Joseph A. Stucky, Lexington
11th " John D. Jackson, Danville

OHIO

EXECUTIVE COMMITTEE
Chairman, Charles S. Hamilton, Columbus
Secretary, J. Edward Pirrung, Cincinnati
Counselor, Walter H. Snyder, Toledo

REPRESENTATIVES, Term expiring 1920
Senatorial, J. Edward Pirrung, Cincinnati
2nd District, Joseph Arda Hall, Cincinnati
4th " Harry S. Noble, St. Marys
6th " James William Fitch, Portsmouth
8th " C. E. Sawyer, Marion
10th " Dan Feurt Gray, Ironton
12th " James F. Baldwin, Columbus
14th " Roy H. McKay, Akron
16th " Logan B. Zintsmaster, Massillon
18th " Henry K. Yaggi, Salem
20th " William E. Lower, Cleveland
22nd " Daniel W. Shumaker, Dover

Term expiring 1921
Senatorial, Benjamin R. McClellan, Xenia
1st District, J. Hadley Caldwell, Cincinnati
3rd " L. G. Bowers, Dayton
5th " Charles W. Moots, Toledo
7th " Charles L. Minor, Springfield
9th " George M. Todd, Toledo
11th " Charles S. Hamilton, Columbus
13th " Charles Graefe, Sandusky
15th " Henry Thomas Sutton, Zanesville
17th " Wilson M. McClellan, Ashland
19th " James A. Sherbondy, Youngstown
21st " James Craven Wood, Cleveland

INDIANA

EXECUTIVE COMMITTEE
Chairman, Miles F. Porter, Fort Wayne
Secretary, Stanley A. Clark, South Bend
Counselor, James Y. Welborn, Evansville

REPRESENTATIVES, Term expiring 1920
Senatorial, Edwin Walker, Evansville
2nd District, Charles E. Barnett, Fort Wayne
4th " Alfred P. Roope, Columbus
6th " Charles Marvel, Richmond
8th " Maynard Alvernise Austin, Anderson
10th " Richard B. Wetherill, LaFayette
12th " Luzerne H. Cook, Bluffton
At Large Miles F. Porter, Fort Wayne

Term expiring 1921
Senatorial Joseph Rilus Eastman, Indianapolis
1st District, James Y. Welborn, Evansville
3rd " John Paul Salb, Jasper
5th " Spencer M. Rice, Terre Haute
7th " John H. Oliver, Indianapolis
9th " Paul J. Barcus, Crawfordsville
11th " Edward H. Griswold, Peru
13th " Stanley A. Clark, South Bend

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